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Engineering students' experiences of learning entrepreneurial competencies during university studies

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Tiivistelmä - Referat - Abstract

Tavoitteet. Aikaisempi yrittäjyyskasvatuksen tutkimus on perustunut pääasiassa kvantitatiiviseen lähestymistapaan ja se on keskittynyt tuloksellisuuteen taloudellisten motiivien ohjaamana. Yrittäjyyskompetenssit on käsitetty mahdollisina oppia ja opettaa, vaikkakin näyttö yrittäjyyskoulutuksen tuloksellisuudesta on ollut ristiriitaista. Yrittäjyyskasvatuksen koulutuksellisen prosessin tutkimus on jäänyt vähäiseksi. Tutkijat ovat suositelleet sosiokonstruktivistisia ja kokemuksellisia pedagogisia lähestymistapoja yrittäjyyskasvatukseen. Tämän tutkimuksen tavoitteena on yhdistää aiemmin erillisiä koulutuksen tuloksiin ja prosessiin liittyviä näkökulmia, ja siten muodostaa syvällisempi kuva yrittäjyyskompetenssien oppimisesta opiskelijoiden näkökulmasta.

Menetelmät. Tutkimus toteutettiin haastattelemalla 18 viidennen vuoden insinööriopiskelijaa, jotka olivat aloittaneet opintonsa 1.8.2013. Haastattelukutsut kohdennettiin opiskelijarekisteritietojen pohjalta siten, että tavoitettiin mahdollisimman erilaisia yrittäjyyteen keskittyviä opintojaksoja suorittaneita opiskelijoita. Tutkimusinstrumentti rakentui narratiiviselle tutkimukselle, kriittisten tapahtumien tutkimukselle ja elämänviivalähestymistavalle. Aineisto analysoitiin sisällönanalyysia, abduktiivista päättelyä sekä aineiston kvantifiointia hyödyntäen.

Tulokset ja johtopäätökset. Aiempien tutkimusten suuntaisesti yrittäjyyskompetenssit osoittautuivat mahdollisiksi oppia. Kaikki opiskelijat tunnistivat bisnesosaamisen kehittymistä. Varhaisvaiheen yrittäjyyttä tukevien kompetenssien oppimiskokemukset painottuivat kuitenkin useita yrittäjyyskursseja suorittaneille opiskelijoille. Oppimisprosessia koskevat tulokset osoittivat, että yrittäjyyskompetenssien laaja-alainen oppiminen mahdollistui yhdistämällä formaaliin oppimiseen informaaleja elementtejä. Kursseilla oppimisessa painottuivat etenkin ongelmanratkaisua ja projektityöskentelyä sisältävät ympäristöt, joissa opiskelijat työskentelivät poikki- tai monitieteellisissä ryhmissä. Muut kuin yrittäjyyskurssit eivät suoraan tukeneet yrittäjyyskompetenssien kehittymistä. Yrittäjyyskurssien osia voi olla kannattavaa sisällyttää jatkossa erityisesti projektikursseihin.

Avainsanat – Nyckelord insinööriopiskelijat, yrittäjyyskasvatus, yrittäjyys, kompetenssi, oppiminen	
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Tiivistelmä - Referat – Abstract

Aims. Previous research on entrepreneurial education has mainly been driven by economic interest. It has been based on quantitative approaches focusing on learning outcomes. Entrepreneurial competencies have been observed as learnable and teachable, although there has been contradictory evidence about effectiveness of entrepreneurial education. Process perspective on entrepreneurial education has left as a minor viewpoint. By now, researchers' have recommended socio-constructive and experiential approaches to pedagogics. The objective of this study is to bring together previously separate research traditions on educational outcomes and process, introducing more profound picture of learning entrepreneurial competencies especially from the students' perspective.

Methods. The study was conducted by interviewing 18 fifth-year engineering students, who had started their studies on August 1, 2013. The interview invitations were targeted based on study register data for reaching participants from diverse backgrounds on entrepreneurial studies. The research instrument was built on directions of narrative research, critical incident technique and lifeline approach. The data were analyzed with content analysis combined with abductive reasoning and data quantification.

Results and conclusions. Consistently with the previous studies, entrepreneurial competencies were shown possible to learn. All students recognized learning of business competencies. However, competencies needed in early-phase entrepreneurship were emphasized by students, who had accomplished several entrepreneurial courses. Results concerning learning process indicated that combining formal learning environments with elements of informal learning resulted as a wide spectrum of learned entrepreneurial competencies. Learning was located especially in problem-solving and project working environments where students co-worked in inter- or multidisciplinary groups. However, other than entrepreneurial courses did not directly support learning of entrepreneurial competencies. Thus, the findings set base for further actions in integrating the elements of entrepreneurial courses into project courses.

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1 Introduction

Entrepreneurship is often agreed to be a generator of economic growth and employment (Egerová, Eger, & Mičík, 2017; Meyer & Meyer, 2017; Stamboulis & Barlas, 2014). In addition to educating workforce for companies, universities are considered as a base for creating ventures and providing students knowledge needed for running businesses (Egerová et al., 2017; Lautenschläger & Haase, 2011). For example, European Commission (2013) has emphasized the role of entrepreneurial education in delivering new ventures. During the past decades, universities' interest towards organizing entrepreneurial courses has increased explosively (Blenker, Trolle Elmholdt, Hedeboe Frederiksen, Korsgaard, & Wagner, 2014; Maritz, 2017; Rideout & Gray, 2013; Sirelkhatim & Gangi, 2015). Since entrepreneurial competencies are overlapping with generic working life competencies, developing them is viewed useful for students from all disciplines (Boyles & College, 2012; Kucel, Róbert, Buil, & Masferrer, 2016). Currently entrepreneurial courses are being offered to also other than business students (Frank, 2007).

In Finland, many higher education providers have started to offer entrepreneurial education as a part of their curricula. Among others, Aalto University has recorded development of entrepreneurial education in its strategy for years 2016 - 2020 (Aalto University, 2015). This Master's thesis is linked to the Entrepreneurship Ecosystems in Engineering and Technology Erasmus+ project, within which Aalto University and six other European technical universities develop entrepreneurial education in cooperation both inside the universities and between of them (see European Commission, n.d.). The project is implemented by developing ways to integrate entrepreneurial courses as part of existing courses of engineering degree programs, creating programs for developing university teachers' pedagogical expertise in facilitating learning of entrepreneurial competencies and building a cooperation model for a student exchange program (European Commission, n.d.). For a basis of pedagogical development work, this study aims to offer context-related information about engineering students' experiences of learning entrepreneurial competencies during studies in Aalto University.

Entrepreneurial competencies are typically defined as qualities that are needed for successful acting as an entrepreneur (Man, Lau, & Chan, 2002; Markman, 2007; Mitchelmore & Rowley, 2010). They are also considered to have general value in working life for all disciplines (Boyles & College, 2012; Henry, 2013; Kucel et al., 2016). Together with motivation of goal achievement, entrepreneurial competencies produce behavior, which is observed as entrepreneurial action (Robles & Zárraga-Rodriguez, 2015). The competency categorization developed for this study, bases on the commonly used definition of competencies as integrated bunches of knowledge, skills and attitudes (see Fisher, Graham, & Compeau, 2008; Komarkova, Conrads, & Collado, 2015; Láckeus, 2015, 2014; Man et al., 2002; Markman, 2007; Sánchez, 2011).

Development of students' entrepreneurial competencies is strived to support by organizing entrepreneurial education (Boyles & College, 2012; Mwasalwiba, 2010; Sirelkhatim & Gangi, 2015). Entrepreneurial education is often defined through three different objectives: educating 'about', 'for' or 'through' entrepreneurship (Gibb, 1993; Kirby, 2004; Laukkanen, 2000). These objectives are connected to different aims and parts of entrepreneurial competencies, which to are intended to influence (Mwasalwiba, 2010; Pittaway & Edwards, 2012). The objectives of courses are also attachable to particular contents or themes as well as pedagogical methods (Pittaway & Edwards, 2012; Sirelkhatim & Gangi, 2015).

Previous research of entrepreneurial education has mainly focused on economic interest: quantitatively measuring the outcomes of programs and courses (Mwasalwiba, 2010). Evidence about effectiveness of entrepreneurial education courses or programs is contradictory. Some studies have shown *effects to entrepreneurial competencies* (Barba-Sánchez & Atienza-Sahuquillo, 2018; Din, Anuar, & Usman, 2016; Karimi, Biemans, Lans, Chizari, & Mulder, 2016; Maresch, Harms, Kailer, & Wimmer-Wurm, 2016, Mueller, 2011; Packham, Jones, Miller, Pickernell, & Thomas, 2010; Zhang, Duysters, & Cloodt, 2014), whereas others have found entrepreneurial education *ineffective* (Graevenitz, Harhoff, & Weber, 2010; Oosterbeek, van Praag, & Ijsselstein, 2010).

Common criteria for assessing the impacts of entrepreneurial education is missing, which has resulted in several ways of assessing and measuring success

of educational interventions (Fayolle & Gailly, 2015; Henry, Hill, & Leitch, 2007; see also Fayolle, Gailly, & Lassas-Clerc, 2007; Rideout & Gray, 2013; Schelfhout, Bruggeman, & De Maeyer, 2016). Entrepreneurial competencies are typically assessed with pre-post skill-based tests, focusing mainly on one entrepreneurial course or study program at a time (Jensen, 2014; Mitchelmore & Rowley, 2010; Schelfhout et al., 2016). This kind of focus on outcomes has left educational process perspective into shadow (Fayolle et al., 2007; Lans, Oganisjana, Täks, & Popov, 2013).

The key characteristics of teaching methods that support learning entrepreneurial competencies have not been systematically identified yet, even though researchers recommend socio-constructive and experiential approaches to pedagogics (Fayolle & Gailly, 2015; Florin, Karri, & Rossiter, 2007; Kirby, 2004; Láckeus, 2014; Markman, 2007; Nygaard, Højlt, & Hermansen, 2008; Pittaway & Cope, 2007b). These solutions have been considered as promising novel ways of teaching in engineering education (see Borrego, Froyd, & Hall, 2010; Dym, Agogino, Eris, Frey, & Leifer, 2005). However, they are not widely applied, mainly due to universities' research-centered organization structures and teaching traditions still favoring lecturing (Borrego et al., 2010; Felder, Stice, & Rugarcia, 2000).

For producing more information about entrepreneurial learning process, qualitative research focusing on students' experiences has been suggested (Egerová et al., 2017; Hindle & Yencken, 2004; Mitchelmore & Rowley, 2010). Heretofore, only a few researches have followed this agenda (e.g. Chang & Rieple, 2013; Kakkonen, 2012b, 2011; Láckeus, 2014). The question still remains, how students perceive entrepreneurship education: what kinds of entrepreneurial competencies they learn and in what kinds of environments their competencies develop during studies?

The purpose of this Master's thesis is to explore what kinds of entrepreneurial competencies students report to have learnt during studies. In addition, it aims to identify in what kinds of learning environments students report to have learnt entrepreneurial competencies. The research also aims to uncover relations between learning experiences and environments. This approach brings together

two research traditions previously mainly considered separately: educational outcome and learning process perspectives (see Blenker et al., 2014), thus providing a holistic view of entrepreneurial learning.

2 Entrepreneurial competencies

In the field of entrepreneurship research, the words *competency* (pl: competencies) and *competence* (pl: competences) are often used interchangeably (see Hanhinen, 2010; Kakkonen, 2012a; Mitchelmore & Rowley, 2010). The concept of competency refers to a class of things possible to use for classifying individuals and their behavior, while as the concept of competence refers to evaluation in certain domain of activity (Mitchelmore & Rowley, 2010). A competency can be viewed as a part of competence needed in a certain job (Hanhinen, 2010). In this research the term competency is used consistently to describe competencies that are required in entrepreneurs' work.

Generally, competencies are considered as abilities to make intentional decisions in non-routine situations by utilizing knowledge and skills (Westera, 2001). They are defined as collections of integrated *knowledge, skills and attitudes*, which together with motivation promote executing a certain task or achieving a certain goal (Chell, 2013; Fisher et al., 2008; Komarkova et al., 2015; Láckeus, 2015, 2014; Man et al., 2002; Sánchez, 2011; Strijbos, Engels, & Struyven, 2015). There are various other definitions of competency parts; some researchers add also abilities as fourth integrated competency part or define competencies solely as abilities (Boyles & College, 2012; Hanhinen, 2010; Mitchelmore & Rowley, 2010). However, the widely used three-part definition chosen is in line with philosophically constructed theory of the three dimensions of human mind: "cognition, conation and affection", which has long roots in German psychology of the eighteenth century (Fisher et al., 2008; Hilgard, 1980; Kraiger, Ford, & Salas, 1993; Láckeus, 2014). This definition highlights different qualities of competencies in learning and enables considering these fundamental differences in analyzing learning (Láckeus, 2014).

In line with the general definition of competencies, the concept entrepreneurial competencies is used to reflect an ability of the entrepreneur to perform their work successfully (Man et al., 2002; Mitchelmore & Rowley, 2010). Traditionally, entrepreneurship is observed as self-oriented behavior and ownership of enterprise but now the definition has expanded to cover more kinds of

entrepreneurship (Kyrö & Carrier, 2005). In particular, concepts of corporate entrepreneurship and intrapreneurship are used to refer entrepreneurial action in already existing organizations (Støren, 2014). Employees who have received entrepreneurial education before graduating are more innovative at work (Bjornali & Støren, 2012). Additionally, entrepreneurship education before graduating can help in finding work that is more suitable (Kucel et al., 2016). Again, students often hope to learn entrepreneurship competencies for life, not only for founding start-ups (Bridge, 2017). Althogether, learning entrepreneurial competencies is viewed useful also for students aiming to work as employees instead of entrepreneurs, because entrepreneurial competencies are highly valuable by employers (Boyles & College, 2012; Henry, 2013; Kucel et al., 2016).

Recognizing the society's diverse needs for entrepreneurial competencies (see Robles & Zárraga-Rodríguez, 2015), in this research, they are observed in the wider context of working life competencies (see Figure 1). Typically, the competencies that are needed in working life, are separated into two categories: generic competencies and competencies specific to a certain profession (here described with term domain-specific competencies) (Jääskelä, Nykänen, & Tynjälä, 2018; Strijbos et al., 2015). Entrepreneurial competencies are closely connected to both of these categories. They are greatly overlapping with generic competencies (Boyles & College, 2012; Kakkonen, 2012b). Respectively, they can be viewed as overlapping with domain-specific competencies, including both subcompetencies centric in a person's own professional field (see Lans, Blok, & Wesselink, 2014; Ucbasaran, Westhead, & Wright, 2008) and subcompetencies required specifically in entrepreneurial action (see e.g. Draycott & Rae, 2011).

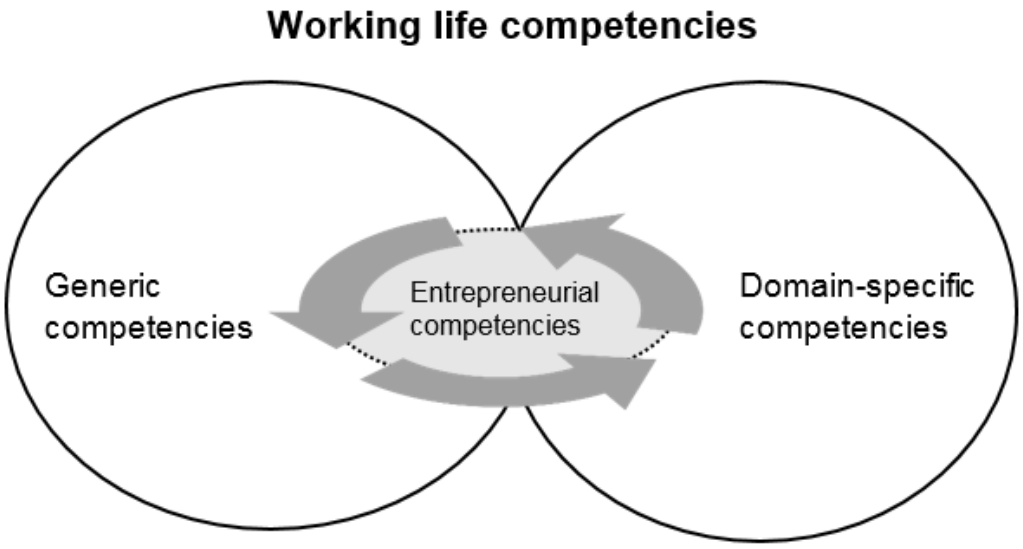

Figure 1. Entrepreneurial competencies in the context of working life competencies (based on Barberà et al., 2014; Bennett et al., 1999; Chan & Fong, 2018; Clanchy & Ballard, 1995; Green et al., 2009; Henry, 2013; Jääskelä et al., 2018; Kakkonen, 2012b; Markman, 2007; Nab et al., 2007; Tuononen et al., 2017; Vaastra & De Vries, 2007)

Generic competencies are viewed as transferrable, multifunctional and applicable in several fields - not tightly bound in a certain study or work context (Jääskelä et al., 2018). They are also referred for example with words “transferrable”, “key”, “enabling”, and “core” and sometimes also word “competencies” is replaced with “skills”, “attributes” and “capabilities” (Green, Hammer, & Star, 2009; Jääskelä et al., 2018). Generic competencies are perceived to have a role in enhancing possibilities in getting job after graduating from university and in enabling lifelong learning required in rapidly changing world and work tasks (Tuononen, Parpala, & Lindblom-Ylänne, 2017; Tynjälä, Slotte, Nieminen, Lonka, & Olkinuora, 2006). Some of the generic competencies are seen supportive for entrepreneurial action regardless the field of venturing, for example social competencies, consequently part of generic competencies can be also observed as entrepreneurial competencies (see e.g. Henry, 2013; Kakkonen, 2012b).

In addition to generic competencies, working life competencies include *domain-specific competencies*, which are needed in a specific profession (Barberà, Layne, & Gunawardena, 2014; Bennett, Dunne, & Carré, 1999; Tuononen et al.,

2017). Their position related to entrepreneurial competencies is important to recognize, because an entrepreneur usually works in a particular field. To illustrate, a software developer has to master certain tools in their work. Thus, if they want to start a business of their own, domain-specific competencies of their own field are essential. However, this is not enough for an entrepreneur.

In contrast to working as an employee, the process nature of entrepreneurial action sets special competency requirements. It requires *entrepreneurship-specific competencies* (domain-specific competencies on entrepreneurship) (Markman, 2007; Nab, Pilot, Brinkkemper, & ten Berge, 2007), more specifically related to the market of the field (Lans et al., 2014). Entrepreneurial action is viewed as a process, where are certain steps that include different activities: the emergence, recognition and evaluation of opportunities, assembly of required resources, development of strategy and actual exploitation (Baron, 2007). Despite the fact that entrepreneurial action has process-nature, it is not following certain steps in a linear order – it can not be predicted (Neck & Greene, 2011).

The entrepreneurship-specific competencies are seen as action-oriented and supportive for different phases of entrepreneurial process, in other words, especially for recognition and exploitation of opportunities (Baron, 2007; Chell, 2013). Roughly divided, competencies that support opportunity recognition are especially useful in the beginning and competencies related to business running are usable after venture creation (Baron, 2007). The role of entrepreneurship-specific competencies is assumed to appear significantly in so-called weak situations, where are no clear procedures how to do certain things (especially in startup environments), consequently leading to emphasis of individual differences in behavior (Markman, 2007).

The process arrow in the Figure 1 takes into account the dynamic interaction of generic and domain-specific competencies. The process of learning these competencies is complex and intertwined (see e.g. Vaastra & De Vries, 2007). There has been a long-time debate about the dichotomy, because generic competencies can be also viewed at least partly context-related (Green et al., 2009; Jääskelä et al., 2018). A person's own field can affect interpretation of importance of a certain generic competency or a way that a generic competency

is seen (Chan & Fong, 2018; Tuononen et al., 2017). For example, critical thinking skills are related to previous information about an object, in other words information about a context has a role in a process (Moore, 2004). Additionally, personal transfer between field-specific competencies and generic competencies might happen; if something is already learned in a certain context, there is no need to learn it as completely new in another context (Clanchy & Ballard, 1995).

In conclusion, consistently with Kakkonen (2012b) in this research the most centric competencies related to entrepreneurial action are referred with the term entrepreneurial competencies, separated to two subcategories of “generic entrepreneurial competencies” overlapping with generic competencies, and “entrepreneurship-specific competencies” related specifically to entrepreneurial process. Equally, Draycott and Rae (2011) have separated “soft” transferrable entrepreneurial competencies from “hard”, entrepreneurship-specific, business-related competencies.

2.1 Role of entrepreneurial competencies

Entrepreneurial action is possible to regard on the top of the iceberg, where different levels interact with each other (Bergenhenegouwen, ten Horn, & Mooijman, 1996; Jones, Voorhees, & Paulson, 2002; Kakkonen, 2012b; Mateo, Escofet, Martínez-Olmo, Ventura, & Vlachopoulos, 2012; Voorhees, 2001) (see Figure 2). The figure illustrates the relationship of personal innate low-level traits and attributes, competency components related to the integrated competencies and entrepreneurial action.

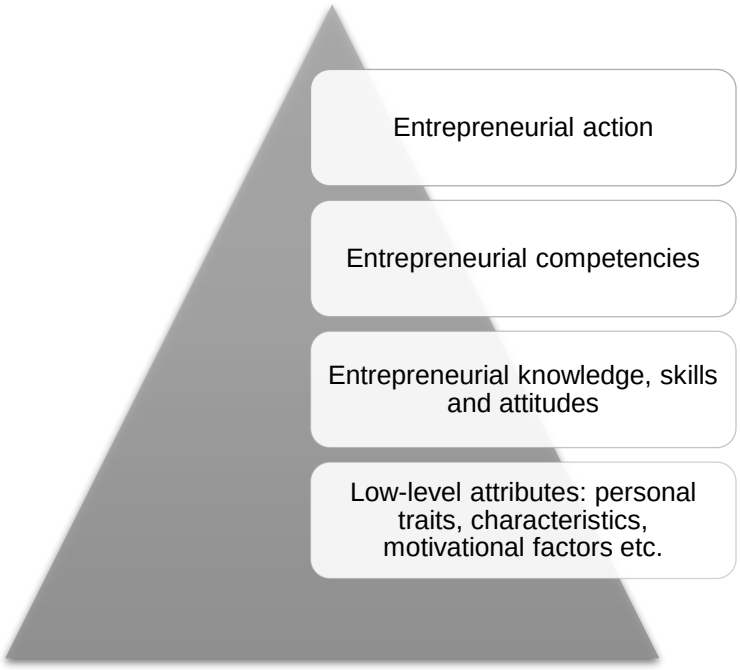

Figure 2. Role of entrepreneurial competencies in entrepreneurial action (adapted from Bergenhenegouwen et al., 1996; Jones et al., 2002; Kakkonen, 2012b; Mateo et al., 2012; Voorhees, 2001)

Starting from the bottom-level of hierarchy, various *low-level attributes*, such as personal traits, characteristics and motivational factors, are the deepest roots of entrepreneurial action. These low-level attributes have large importance in entrepreneurial behavior, since differencies in them clarify, why people acquire different learning experiences, thus achieving individual levels of competencies (Bergenhenegouwen et al., 1996; Mateo et al., 2012; Voorhees, 2001). They have especially large impacts on entrepreneurial attitudes (Chen & Lai, 2010). However, these attributes are difficult to learn as well as to observe in real-life

situations (Bergenhenegouwen et al., 1996). Besides, trait-approach to entrepreneurship research has faced difficulties with identifying a coherent set of entrepreneurial traits, which has led to focusing on competencies entrepreneurs need in their work (Mitchelmore & Rowley, 2010).

Consistently, this study focuses on *competencies* (covering the three highest levels of iceberg of Figure 2). They are possible to educate better than stable low-level elements (Lans et al., 2014; Oosterbeek et al., 2010). Here, competencies are viewed as integrated bunches of knowledge, skills and attitudes that form prerequisites for successful entrepreneurial action (e.g. Man et al., 2002; Markman, 2007; Mitchelmore & Rowley, 2010). In the following, a more detailed description covers these aspects, starting from knowledge, skills and attitudes (competency components), continuing with their integration into competencies, and ending up with entrepreneurial action.

The three competency components, *knowledge, skills and attitudes*, have their own roles in entrepreneurial action, even though they all are needed for effective entrepreneurial action (see Markman, 2007; Taconis, van der Plas, & van der Sanden, 2004). They are interrelated more than discrete (Kraiger et al., 1993). Knowledge, skills and attitudes can be acquired separately from different environments and situations, such as school, home, social situations and work (Mateo et al., 2012). They integrate into competencies (see Figure 3) through experiences, in which they are actively practiced for producing desired action (Voorhees, 2001; Mateo et al., 2012). Correspondingly, in the Figure 2, this transition is illustrated with rising abstraction level between the two middle levels of the hierarchy.

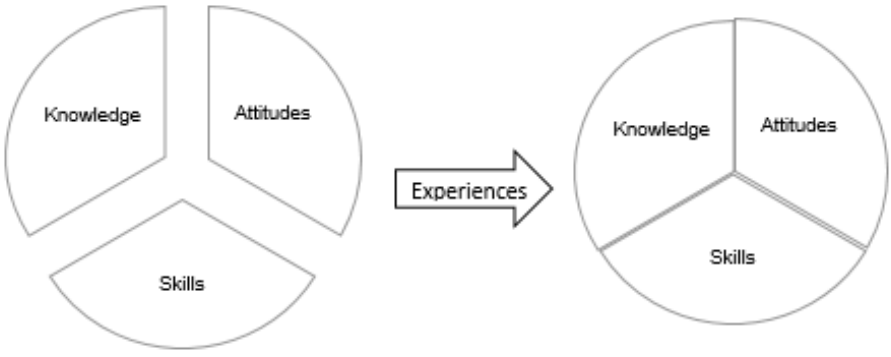

Figure 3. Integration of competency components

Describing the roles of these three components in more detail, the first is *knowledge*, a person's perceptual experience of reality (see Nygaard et al., 2008). Several types of knowledge are useful in entrepreneurial action: declarative knowledge (about things themselves), procedural knowledge (about how to do things), strategic knowledge, and tacit knowledge (information about what and when) (Kraiger et al., 1993). Knowledge supports especially opportunity recognition process: it is needed in recognition action itself as well as making valuations, assessment of opportunities and carrying out tasks and solving problems to exploit opportunities (Markman, 2007).

Skills, as the second competency dimension, are defined as proficiency to execute tasks, for example develop products, work with people, and organize venture operations (Chell, 2013; Markman, 2007). Again, knowledge a base for entrepreneurial mindset, which enables applying skills and knowledge in entrepreneurial action (Kraiger et al., 1993; Krueger, 2007). Knowledge has different role for beginning entrepreneurs and experienced entrepreneurs; learning modifies both knowledge content and structure (Krueger, 2007). When a person starts their career as an entrepreneur and has to do marketing, they use more declarative knowledge compared to experienced entrepreneurs to support required marketing skills, for example marketing products and services and getting people excited about their ideas (see Fisher et al., 2008; Kraiger et al., 1993).

The relation of skills and knowledge also changes with learning when mental models and cognitive strategies are developed (see Kraiger et al., 1993). Through accumulation of experience confidence to applying procedural knowledge increases; knowledge is organized into mental models which affects to an entrepreneur's capacity to perceive problem settings and relations between different matters (Fisher et al., 2008; Kraiger et al., 1993). As an example of mental models, Láckeus (2014) mentions risk and probability models. Returning to the previous example about marketing, these mental models might also embody conceptions how marketing should be carried out for best success. Additionally, cognitive strategies develop through gaining more experience to enhance capability to apply skills and knowledge in a certain situation (Kraiger et

al., 1993). To illustrate, one important mental model for entrepreneurs' is to know how to get things done without resources (Fisher et al., 2008).

The third competency category, *attitudes*, represents person's evaluation of a particular object, which can also be abstract (Ajzen & Fishbein, 1977). Entrepreneurial action is affected by observations concerning how desirable a certain action is perceived (Kraiger et al., 1993). According to Ajzen's theory of planned behavior, positive attitude towards a certain behavior strengthens intention, which is how much person is ready to try in order to behave in certain way (Ajzen, 1991). Attitudes have a mediating role; they affect intentions, which precede behavior (Krueger, 2007). In other words, by developing a positive attitude towards entrepreneurial action, it is more likely to enhance a person's entrepreneurial intention, and possibly to act entrepreneurially (and begin venturing). Therefore, developing attitudes along with knowledge and skills are viewed necessary in entrepreneurial education (Florin et al., 2007). Integration of competency parts and development of entrepreneurial mindset enables entrepreneurial professional action in future (Krueger, 2007; Nygaard et al., 2008).

The highest level of hierarchy in Figure 2, *entrepreneurial action* is most closely related to entrepreneurs' success (Man et al., 2002). It is typically described through behaviors that support value creation, for example opportunity seeking, taking initiatives, making decisions, solving problems, taking responsibility, networking with others and taking calculated risks (Chell, 2013; Gibb, 2005). Entrepreneurship is regarded as creating new value and accelerating economic growth by generating new activities (Láckeus, 2014; Robles & Zárraga-Rodríguez, 2015).

In competency-based learning models, the observable action forms the assessment criteria (Béchard & Grégoire, 2005; Voorhees, 2001). That is to say, desirable entrepreneurial action is approached as evidence from mastering competencies (see Man et al., 2002; Mateo et al., 2012). Even though the focus here is on individual factors, existence of situational variation should not be forgotten. Competencies are suggested to describe potential for entrepreneurial action; rather, they are not necessarily used in every situation due to several other

context-related factors (see Baartman, Bastiaens, Kirschner, & van der Vleuten, 2007).

2.2 Entrepreneurial competencies in the present study

In the following, the most centric entrepreneurial competencies are introduced (see Table 1) attached to entrepreneurial action. The purpose was not to create a pervasive list of competencies. This kind of aim would be pointless, because there is a lack of comprehensive view about competencies and the list of included factors would be nearly endless (Lans et al., 2014). In addition, importance of different competencies might vary according to who makes interpretations about them (see Eraut, 1998).

Competencies are described here as integrated entities, not through their parts. This solution is justified. Firstly, because of integrated nature of competencies makes it difficult to divide them in subparts (Markman, 2007). Secondly, in the context of entrepreneurial education, this kind of breakdown would not be meaningful, since none of competency parts is sufficient alone to enable entrepreneurial action (see Taconis et al., 2004). Thirdly, defining a set of clear distinctive categories is a difficult task (Kakkonen, 2012a). In conclusion, the following categories are interrelated, which makes distinctions artificial to some extent. Still, entrepreneurial competencies are roughly divided to “generic” and “entrepreneurship-specific” categories presented above.

Table 1.

Entrepreneurial competencies in the present study

Entrepreneurial competencies	
Generic	Entrepreneurship-specific
• Social, collaboration and communication • Information processing and problem solving • Learning and reflection • Ethical • International	• Opportunity recognition • Business • Industry-specific • Networking • Commitment and perseverance

Note. Based on Fisher et al., 2008; Gibb, 2005; Ismail et al., 2015; Kakkonen, 2012a; Láckeus, 2014; Lans et al., 2014, 2011; Man et al., 2002; Mitchelmore & Rowley, 2010; Schelfhout et al., 2016.

2.2.1 Generic entrepreneurial competencies

Generic entrepreneurial competencies form a base for applying entrepreneurship-specific competencies (Bergenhenegouwen et al., 1996; Vaastra & De Vries, 2007). In this category the competencies chosen from entrepreneurship researchers' definitions (Fisher et al., 2008; Gibb, 2005; Ismail, Zain, & Zulihar, 2015; Kakkonen, 2012a; Láckeus, 2014; Lans et al., 2014; Man et al., 2002; Mitchelmore & Rowley, 2010; Schelfhout et al., 2016) are greatly overlapping with generic competency clusters described by Strijbos et al. (2015). Here, the competencies are described through related behaviors.

First, importance of *social, collaboration and communication* competencies is emphasized by several sources (e.g. Fisher et al., 2008; Mitchelmore & Rowley, 2010; Schelfhout et al., 2016). Interpersonal skills overall are important in entrepreneurial action (e.g. Láckeus, 2014). To act successfully, a person has to realize that other people are needed to be in connection for getting ideas implemented (Oosterbeek et al., 2010). These competencies appear not only in working with employees but also as ability to manage customers (Mitchelmore & Rowley, 2010). The need of competencies in this category is easily imagined to any situation where several persons are working together, such as group or

project works at university courses. Social, collaboration and communication competencies show up intertwined as listening, persuasion, written, and oral communication, working actively with others in an empathetic manner, offering assistance when needed and resolving conflicts (Fisher et al., 2008; Mitchelmore & Rowley, 2010). In addition, communicating a vision to others and "sticking up for own vision but letting go if necessary" were mentioned (Morris, Webb, Fu, & Singhal, 2013; Schelfhout et al., 2016).

Secondly, *information processing and problem solving* competencies support entrepreneurial action in making decisions, solving different problems, understanding complex information, taking risks, and being innovative (Man et al., 2002). These competencies support especially opportunity recognition (see e.g. Kyndt & Baert, 2015), which is one of entrepreneurship-specific competencies introduced later. Processing information innovatively and creating novel ideas is important in exploitation of perceived opportunities (Chell, 2013; Gibb, 2005; Ismail et al., 2015; Schelfhout et al., 2016). Taking advantage of opportunities require using judgement to take calculated risks and making decisions, which are seen as essential parts of entrepreneurial action (Covin & Wales, 2012; Gibb, 2005; Ismail et al., 2015; Schelfhout et al., 2016). Information processing and problem solving competencies are interrelated, for example, problem solving requires searching information and processing it, as well as analyzing a problem and developing new solutions creatively (Strijbos et al., 2015).

Thirdly, *learning and reflection* competencies is a combination, which makes possible for a person to not only learn new things but also be aware of learning experiences and assessing, initiating and regulating learning experiences (Strijbos et al., 2015). Entrepreneurial action is possible to stay successful, if a person is oriented towards learning and acquiring competencies that help them to manage new challenges, for example new technical solutions (Kyndt & Baert, 2015). Additionally, successful entrepreneurs have the ability to turn their successes or failures into useful outcomes (Man, 2012). Behaviors related to reflection, as criticality to own contribution, openness to receive criticism from others, and learning from mistakes, are viewed centric in entrepreneurs' learning

(e.g. Lans, Verstegen, & Mulder, 2011; Man, 2012). Lower-level elements have a great role in reflective learning. Again, low-level attributes, such as self-efficacy, affect perception of a person's own competencies and regulate which kind of learning experiences a person is going to attend (see Bandura, 2012; Mateo et al., 2012; Voorhees; 2001).

Fourthly, *ethical* competencies provide a base for acting according to professional ethics (Kakkonen, 2012a; Strijbos et al., 2015). Ethics and moral criteria typical for a certain profession are learned through a long socialization process, where a person acts in a professional group (Kakkonen, 2012b). To make ethical decisions related to business, both "what" and "how" decisions are made is significant, and all stakeholders must be taken into account (Ackoff, 1987). Fairness of entrepreneur's solutions is important also to clients, who buy a brand that is represented by an entrepreneur (Inyang & Enuoh, 2009). Thus, an entrepreneur might face difficult decision-making situations with several different viewpoints, and should have competencies to handle these situations.

Fifthly, *international* competencies are needed in working life, and equally in entrepreneurial action (Kakkonen, 2012a). For everyone, it is necessary to have competencies for living and acting in a cultural context, noticing their own values as a base for action (Olmedo-Torre, Martínez, Perez-Poch, & Garcia, 2018). In the context of entrepreneurial action, for example, when selling products overseas entrepreneurship-specific opportunity recognition competencies cannot be applied per se, which means that international competencies are required to support using them (see Lehto, 2015). Those persons, who start new international ventures, have developed in their earlier activities competencies to recognize opportunities from other cultures and exploit resources from several markets (Andersson & Evers, 2015; Phillips Mcdougal, Shane, & Oviatt, 1994).

2.2.2 Entrepreneurship-specific competencies

Turning to entrepreneurship-specific competencies that are not overlapping with generic competencies, but instead enabling actions, which are strongly related to business and entrepreneurial action (Draycott & Rae, 2011). Recalling the Table 1, the first two items in the list of entrepreneurship-specific competencies are opportunity recognition competencies and business competencies. They are related to the phases of entrepreneurial process. Opportunity recognition competencies are important in the starting phase of process, which is associated with recognition of problem or need and developing suitable solutions to it, while business competencies are needed in running business after developing an idea (Lans et al., 2014). These two categories make evident the main roles of an entrepreneur: the entrepreneurial role and the managerial role (Mitchelmore & Rowley, 2010).

Opportunity recognition competencies support behavior, which is typical solely for entrepreneurs and clearly distinctive from managerial tasks (Mitchelmore & Rowley, 2010; Shane & Venkataraman, 2000). Observing an opportunity requires active seeking and scanning environment, which is followed by actual recognition of opportunities and acting on them (Fisher et al., 2008; Gibb, 2005; Mitchelmore & Rowley, 2010). To develop suitable solutions, prototyping and product development competencies are needed (Láckeus, 2014; Mitchelmore & Rowley, 2010). Initiativity is closely related to these actions: an entrepreneur should take initiative to make things happen (Gibb, 2005; Schelfhout et al., 2016). Various conceptual competencies, for example creativity and decision-making, are notably supporting the cognitive processes entrepreneur needs in the starting phase of a venture (Kyndt & Baert, 2015; Man et al., 2002).

Business competencies support exploitation of business idea by organization of resources and strategies, which in practice is managing a small firm (Lans et al., 2014, 2011; Mitchelmore & Rowley, 2010). In particular, business competencies are divided into organizing competencies and strategic competencies (Man et al., 2002). An entrepreneur organizes resources that can be internal or external and relate to technology, finance, human, or physical objects (Lans et al., 2011). Financial and human issues are most often mentioned. Behaviors related to

finance, are for example creating a business and financial plan, budgeting, obtaining financing, and acquiring and developing resources (Fisher et al., 2008; Mitchelmore & Rowley, 2010). Likewise, human relation and leadership competencies are mentioned to support hiring right people, motivating others, stimulating action, delegation of tasks and deal-making (Fisher et al., 2008; Lans et al., 2011; Mitchelmore & Rowley, 2010; Schelfhout et al., 2016).

Strategies are needed for taking advantage of recognized opportunities (Mitchelmore & Rowley, 2010). Developing strategy also for a small business enhances competitiveness of an entrepreneur (Davis & Olson, 2008). Thus, the role of strategic competencies as a part of business competencies is recognized, when it comes to developing a strategy, identifying possible strategic partners, defining vision, setting priorities and focusing on goals (Fisher et al., 2008; Mitchelmore & Rowley, 2010). In formation of strategy, planning things ahead, dividing big tasks into smaller parts and being flexible are important sub-competencies (Draycott & Rae, 2011; Lans et al., 2011; Schelfhout et al., 2016). In that case, utilization of strategic competencies requires mastery of procedural subcompetencies that develop multidirectionally, tied together with conceptual competencies presented earlier in this chapter (see Levin, 2018). Attached to implementation of strategy, several sources suggest usefulness of marketing competencies, more specifically, conducting a market research, assessing the marketplace, marketing products and services and getting people excited about your ideas (Fisher et al., 2008; Láckeus, 2014).

In addition to opportunity recognition and business competencies, also industry-specific competencies, networking competencies and commitment and perseverance competencies are observed to be centric entrepreneurship-specific competencies (e.g. Gibb, 2005; Lans et al., 2014; Man et al., 2002). *Industry-specific* competencies include knowledge about the own field of an entrepreneur bound to information about market of the field (Lans et al., 2014). For example, an engineer specialized to environmental questions willing to start a business in clean-tech field, needs knowledge about clean-tech market for being able to locate the startup into markets. The industry-specific competencies are

connected to entrepreneurs' successful recognition of business opportunities (Ucbasaran et al., 2008).

Even if entrepreneurs managed the individual-level competencies, they need social networks. Competencies that relate to effective *networking* are viewed essential in successful entrepreneurial action (Gibb, 2005). Via formed and maintained networks, an entrepreneur have better access to information, finance and market resources that are success factors in entrepreneurial action (Fornoni, Arribas, & Vila, 2012). Networking capability is linked to success in opportunity perception, in other words knowing people helps to find suitable business opportunities (Shu, Ren, & Zheng, 2018). Other people can also help in acquiring monetary resources, hiring right employees and branding products (Aldrich & Zimmer, 1984, as cited in Lans et al., 2014).

Finally, if a venture should be successful during longer period, *commitment and perseverance* competencies step into a picture. They are related to self-management and learning, and drive an entrepreneur to move ahead (Man et al., 2002). Entrepreneurs have to take responsibility and ownership to their businesses and to manage actions autonomously (Gibb, 2005). To success, they have to be performance oriented; that is they are willing to learn for improving their performance whole time, equally having high quality-criteria for their own work (Lans et al., 2011; Schelfhout et al., 2016). Still some kind of setback may come up, which require endurance and persevarence from an entrepreneur (Ismail et al., 2015; Schelfhout et al., 2016). The commitment and perseverance competencies enable continuing after these setbacks (Schelfhout et al., 2016).

3 Entrepreneurial education

The concept of entrepreneurial education is often approached with pedagogical practices for promoting learning of the entrepreneurial competencies (see Láckeus, 2014; Oosterbeek et al., 2010). Fayolle and Gailly (2008), Béchard and Grégoire (2005) as well as Maritz (2017) have proposed a teaching model framework for entrepreneurial education, which on one hand focuses on ontological level (definition of entrepreneurial education) and on the other hand on educational level (teaching in practice). Formation of teaching model helps to integrate various narrow viewpoints into a more comprehensive conception about how to teach entrepreneurship, which is still under construction in the field of entrepreneurial education (Fayolle & Gailly, 2008). Similarly, this chapter roughly makes difference between ontological and educational levels: it begins at ontological level by defining the concept of entrepreneurial education. The rest of the chapter takes focus on educational level in line with the research agenda on learning experiences (see e.g. Man, 2012; Marton & Booth, 1997).

During recent decades, both researchers' and educational practitioners' interest towards entrepreneurial education overall has been growing continuously (Maritz, 2017; Rideout & Gray, 2013). Thus, it is a current theme to explore, including numerous open questions, starting from the concept definition in general. Coherent definition of the concept of entrepreneurial education is still missing, and the debate is continuing (Lautenschläger & Haase, 2011). Term "entrepreneurial" is used synonymously with "enterprise" and with "entrepreneurship", some researchers questioning the term "entrepreneurship education" as a whole (Bridge, 2017; Mwasalwiba, 2010). Bridge (2017) suggests that the term should not be used, due to varied possible meanings. Henry (2015) reminds that Kilby (1971) described entrepreneurship education with a heffalump analogy: in A.A. Milne's story Winnie the Pooh, heffalump is a mysterious character, which is only imagined but never encountered or captured.

Without sticking to the critique that the concept has received, entrepreneurial education is possible to define through its desirable outcomes. The core assumption of entrepreneurial education is to actively promote developing of

entrepreneurial competencies, rather than to modify participants' personality traits or other low-level attributes (Oosterbeek et al., 2010). Most of the definitions relate entrepreneurial education to a learning process, which aims to influence students' attitudes, behavior, values or intentions (Mwasalwiba, 2010). Narrowly viewed, the focus is to transform students into entrepreneurs, or to develop already working entrepreneurs better (Küttim, Kallaste, Venesaar, & Kiis, 2014; Maritz, 2017).

However, entrepreneurial education can also aim to develop entrepreneurial competencies without a goal of fostering actual entrepreneurship and venture building, but rather teaching entrepreneurial mindsets, broadly useful in working life (Küttim et al., 2014). Therefore, universities are recommended to perceive the curricula objectives of entrepreneurial education more widely than only as producing entrepreneurial competencies for creating new ventures (Henry, 2013; Kakkonen, 2012a). As a recent phenomenon, universities have started to provide entrepreneurial courses also targeted to other than business students (Frank, 2007).

Taatila and Down (2012) bring up that there are not only courses explicitly aiming to develop skills for venture creation for students who see entrepreneurial career as potential to themselves, but also courses that aim to develop motivation or entrepreneurial competencies for students who are not willing to start a venture. The writers punctuate possibility to implicitly develop entrepreneurial competencies even without mentioning the word ”entrepreneurship”, which may have a negative connotation for some students.

Despite of high value of this perspective, it has received little attention from researchers (Egerová et al., 2017). Here, entrepreneurial education is observed as all educational action, which aims to foster students' learning of entrepreneurial competencies at university-level courses. The term “entrepreneurial education” instead of ”entrepreneurship education” is consciously used, in line with the solution to observe entrepreneurial competencies more widely as a part of working-life competencies, as highlighted in Chapter 2.

The chosen interpretation of entrepreneurial education influences its' objectives, orientations and pedagogical approaches (Mwasalwiba, 2010). Several researchers have identified three categories of entrepreneurial education objectives: educating "about", "for" and "through" entrepreneurship (see Table 2). Gibb (1993) first divided objectives to two categories: "about" entrepreneurship and "for" entrepreneurship. The former punctuates entrepreneurship as an academic study area aiming to build knowledge and general understanding of entrepreneurship (Egerová et al., 2017; Gibb, 1993; Jensen, 2014). The latter, "for" objective, highlights developing practical skills needed in creating new ventures and teaching them in experience-oriented way (Gibb, 1993). Laukkanen (2000) presented the same "about" and "for" categories as well. He remarked that universities have more concerns about "for" category because of facilitating students in acquisition of skills needed in starting ventures is less familiar to them, compared to academic research about entrepreneurship.

Later, the list of categories has been expanded with "through", which aims to foster entrepreneurial behavior, including affective aspects (including attitudes), and applying competencies that are needed in finding essential information for starting business (Kyrö & Carrier, 2005). "Through" is viewed more as a teaching approach to entrepreneurship than an objective of education (Mwasalwiba, 2010). Kirby (2004) defines it as a practical approach, where teachers enable students to practice entrepreneurial competencies in creative environment, through venture creation.

Applying teaching methods in practice varies related to which competency parts a course aims to develop. In teaching "about" entrepreneurship, mostly traditional didactical solutions, as lectures, are used (Pittaway & Edwards, 2012). For making the lectures more concrete to students, it is possible to utilize real-life entrepreneurs as visiting lecturers. These kind of role models have been shown to affect students' motivation and positive self-perception to start ventures (Fayolle, Gailly, & Lassas-Clerc, 2006). In "for" approach, skill-based teaching methods are utilized (Sirelkhatim & Gangi, 2015). These can be developing products in teams and different exercises including for example business planning, recognizing opportunities and selling (Piperopoulos & Dimov, 2015;

Sirelkhatim & Gangi, 2015). However, teaching in “for” approach is more simulation-based than in “through” approach, where students are acting as entrepreneurs in supported conditions (Pittaway & Edwards, 2012). This is, in “through” courses students attend for example internships, incubators that prepare them to start ventures or other kind of real-life projects (Chang & Rieple, 2013; Sirelkhatim & Gangi, 2015; Vincett & Farlow, 2008; Wang & Verzat, 2011).

Table 2.

Three objectives of entrepreneurial education

Objective on entrepreneurship	Aim	Examples of methods	Emphasis
“About”	To offer minimum knowledge	Lectures, textbooks	Teacher-centered
“For”	To offer skills besides knowledge	Simulations, product development	Teaching-centered, Learner-centered
“Through”	To offer real-life experience that develop affective competency aspects in addition to knowledge and skills	Internships, incubators, live projects	Learning-centered

Note. Based on Gibb, 1993; Kirby, 2004; Krueger, 2007; Kyrö & Carrier, 2005; Laukkanen, 2000; Mwasalwiba, 2010; Pittaway & Edwards, 2012; Sirelkhatim & Gangi, 2015.

Learning requirements for different competencies vary, even though there is a consensus about overall learnability of them (e.g. Kirby, 2004; Lans et al., 2014; Man et al., 2002; Nab et al., 2007; Robles & Zárraga-Rodríguez, 2015; Voorhees, 2001). In the context of formal education, knowledge and skills (as cognitive and conative elements) are viewed as easier to promote compared to attitudes (as affective elements), of which development is recommended to support by offering emotional-laden experiences in entrepreneurial environment (Florin et al., 2007; Láckeus, 2014; Markman, 2007). More precisely, knowledge is seen as the

easiest to develop of all competency parts (Markman, 2007). In comparison, “through” courses are mentioned as the most demanding to plan, carry out and assess, which may explain observations about wide use of traditional teaching methods in entrepreneurial education (Neck & Greene, 2011; Pittaway & Edwards, 2012; Rahman & Day, 2015). Taken together, the categorization includes a premise about using more experential real-life methods enables promoting development of more competency parts (see Figure 4).

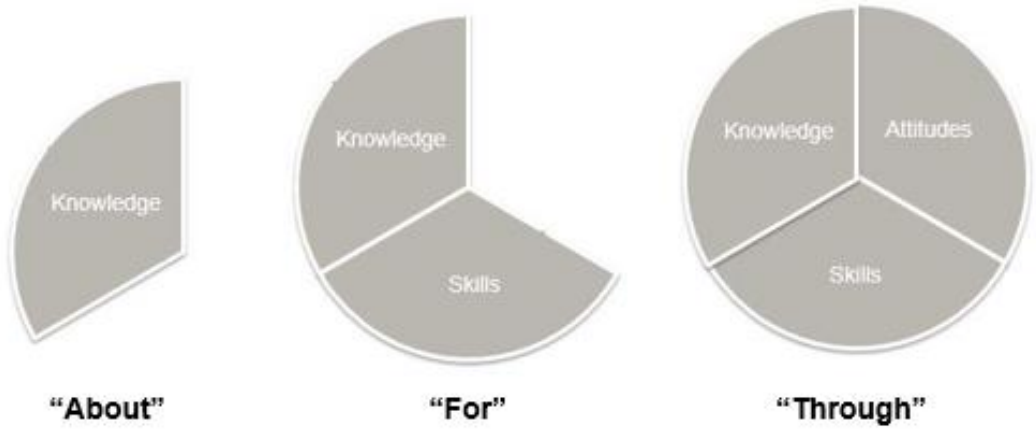

Figure 4. Entrepreneurial competencies related to educational objectives

3.1 Entrepreneurial learning in formal and informal environments

A small part of researchers has questioned entrepreneurship as teachable (e.g. Haase & Lautenschläger, 2011). However, the vast majority of researchers agree that entrepreneurial competencies are possible to teach (e.g. Dickson, Solomon, & Weaver, 2008; Dutta & Merenda, 2011; Egerová et al., 2017; Hindle, 2007; Schelfhout et al., 2016). Following, “how entrepreneurial competencies should be taught” as an unsolved question has become centric in the field (Kirby, 2007). The term “teaching” has traditionally referred to teacher’s action which aims to get students learn (Hirst, 1971). Admittedly, in the context of entrepreneurial education, “teaching” is somewhat misleading term to use, due to researchers have consensus that entrepreneurial education should focus on learning of

competencies, not teaching them (Rahman & Day, 2015; Williams Middleton & Donnellon, 2014). In other words, the focus should be mainly on how to support students' learning. This kind of focus emphasizes outputs of education in contrary to teaching as input, and requires students to take responsibility for their own learning process (Kickul & Fayolle, 2007).

Traditionally, learning can be perceived to happen either in formal environments (e.g. universities) or in informal environments (e.g. at workplace context) (see e.g. Eraut, 2004). Entrepreneurial learning environments of formal education are closer to informal learning than traditional lecture-based methods used in universities, since they simulate or are directly based on authentic working-life situations (see Tynjälä, 2008). This is, they can be perceived to include also elements of informal learning. Conceptions and recommendations of entrepreneurial learning are built mainly on two theoretical starting points: Kolb's experiential learning theory and socio-constructive theories (e.g. Florin et al., 2007; Gibb, 2008; Kirby; 2007; Heinonen & Hytti, 2010; Kyrö, 2005; Láckeus, 2014; Markman, 2007; Mwasalwiba, 2010; Mäkimurto-Koivumaa & Belt, 2016; Neck & Greene, 2011; Pittaway & Cope, 2007b; Nygaard et al., 2008; Schelfhout et al., 2016; Toding, 2017).

Kolb's original experiential learning theory (1984) focuses on a viewpoint of a single person, presenting the four-phased learning cycle, where "knowledge is created through transformation of experience". Kolb (1984) punctuates that learning is a continuous process, which is holistically connected to other life areas. This process has four interrelated phases: concrete experience, reflective observation, abstract conceptualization and active experimentation. According to Kolb, the most centric idea of this learning theory can be described with two terms: concrete experience that helps with testing abstract ideas and feedback, which gives signal of distance to desired goals. Based on experiences and feedback, new abstract ideas are born, thus possible to test in other contexts. The idea is that to learn effectively, all the phases should be gone through, although learning is possible to begin in any of the phases (Kolb, 1984).

Later the theory is proposed to comply with an idea about collective meaning making of experiences through dialogical interaction (Baker, Jensen, & Kolb,

2005). This idea resembles the basis of socio-constructivism in the context of learning, in which emphasis is on collective learning of things that exist as situated and distributed in social context (Zembylas, 2005). Applying socio-constructive approach to learning is seen as a prerequisite in producing competencies for dealing with complex problems, because by learning from simulations it is possible to apply competencies later in real-life situations (Tynjälä, 1999).

Based on the aforementioned theoretical basis on learning, researchers have often outlined two elements as centric for organizing successful entrepreneurial education: learning in heterogenic teams (e.g. Draycott & Rae, 2011; Janssen, Eeckhout, & Gailly, 2007; Toding, 2017; Warhuus, Tanggaard, Robinson, & Moltrup Ernø, 2017) and authenticity of learning environments (e.g. Chang & Rieple, 2013; Kirby, 2007; Láckeus, 2014; Man, 2012). In the following, these themes will be described more comprehensively.

3.1.1 Learning in heterogenic teams

Organizing learning in groups is often seen as a prerequisite for successful entrepreneurial learning (e.g. Toding, 2017). Co-participation builds on idea of socially situated learning that encourages communication and co-operation between participants (Kirby, 2007; Pittaway & Cope, 2007b). In addition, students engage in learning by attending a group learning process (Balan & Metcalfe, 2012). Co-participation may include different stakeholders, such as students, faculty, employers and alumni (Kickul & Fayolle, 2007).

In practice, co-learning is often recommended to be organized in self-selected teams (Pittaway & Cope, 2007b). According to Warhuus et al. (2017) organizing courses in around teamwork is not only a didactic teaching tool. They see it as a fundamental way to enable learning of competencies collectively, and to access eligible learning results. The authors compare group work in a course context to real-life entrepreneurs' utilization of resources bound in other people. Notably, they point out that successful team-based teaching requires teacher in the beginning of the course to explain the role of group in entrepreneurial action to

participants, and to give exercises that support “we” viewpoint more than only focusing to “I” as an entrepreneur. For example, by analyzing students’ reflection questionnaires, Lans et al. (2013) found that students from different backgrounds were at the risk of misunderstanding each other in group work, although heterogeneity of student groups supported students’ learning in general.

Organizing interdisciplinary entrepreneurial courses has become current, because there has been a growing need to integrate entrepreneurship into curricula of several majors (Levenburg, Lane, & Schwarz, 2006). Interdisciplinary approach to project-based learning appears as integration of knowledge from participants’ different disciplines (Janssen et al., 2007). More specifically, by collaborating and managing a project together, students create integrated knowledge; collision of bodies of knowledge results as found interrelation and importance of different disciplines (Rege Colet, 2002, as cited in Janssen et al., 2007). This approach has several advantages. Interdisciplinary is considered as a source of creativity, successful problem solving and opportunity exploration, where students can utilize their academic and discipline-related competencies in different contexts (Draycott & Rae, 2011). Thus, learning comes closer to the real world (García-Rodríguez, Gil-Soto, & Ruiz-Rosa, 2012).

3.1.2 Authenticity of learning environment

Based on students’ experiences authentic environment has shown to be a key element for supporting development of entrepreneurial competencies (Chang & Rieple, 2013; Láckeus, 2014). It makes possible to gain experience by testing concepts and theories in practice (Kirby, 2007). In other words, it enables making active interpretations of experience, develop conceptions and modify them (Man, 2012). This means creating student-centered environments, where hands-on activities and possibilities to learn by creating support students’ inner motivation (Taatila, 2010; Taatila & Down 2012). Also inspiration towards entrepreneurship in addition to usable knowledge and tools should be offered (Kirby, 2004; Sánchez, 2011).

In entrepreneurial courses, teams usually work on projects, which include action-oriented “hands-on” activities (Pittaway & Cope, 2007b). By introducing students open problems and unfamiliar activities, they get a picture of multifaceted nature of problem solving (Kickul & Fayolle, 2007; Kirby, 2007). Simulating entrepreneurial processes, for example financial factors is seen as important (Ciobănică, 2016). Authentic setting is reached by creating various pressures: students face unplanned and unpredictable events, exceptionally challenging objectives, emotional and financial pressures, pressures in timescales, and they may also be forced to make decisions based on incomplete data (Kirby, 2007; Pittaway & Cope, 2007b; Toding, 2017).

In entrepreneurial settings, uncertainty and freedom typically cause mistakes and difficulties, of which overcoming is part of learning (Pittaway & Cope, 2007b). Because students have continuous possibility for failure, they need support from teachers, coaches and tutors (García-Rodríguez et al., 2012; Pittaway & Cope, 2007b). García-Rodríguez et al. (2012) underline giving individual attention as well as suitable tools, spaces and contact, coordination and communication methods. They comment that the whole course may fail, if there are too many students in one group, or too many teams of students in one course. Instead, moderate amount of students and planning learning process as iterative, where content, activities and process itself are present simultaneously, enable reflection (García-Rodríguez et al., 2012; Järvi, 2015; Pittaway & Cope, 2007b).

Turning to learning outcomes, reflective assessment of entrepreneurial competencies is viewed as a centric part of students’ entrepreneurial learning process, especially to observation of experiences acquired from interaction with real world (Draycott & Rae, 2011). Due to competency-based models’ focus on authentic situations and observable behavior, Béchard and Grégoire (2005) recommend using of several different assessment methods to support students’ reflection as a part of a course. They bring up for example portfolios, interviews and direct observations. These methods are not unique to only entrepreneurial education (Pittaway & Edwards, 2012).

A teacher’s assessment, together with students’ and peers’ assessments form a base for continuous feedback in a course (Schelfhout, Dochy, & Janssens, 2004).

Peer-feedback supports both learning of a person who gives and a person who receives it (Mäkimurto-Koivumaa & Belt, 2016). Assessment should punctuate solutions developed to complex problems together with students' experiences on changes that have happened on their knowledge, skills and attitudes (Béchard & Grégoire, 2005; Draycott & Rae, 2011). This is the key difference compared to traditional course assessment methods, such as knowledge-based exams that are seen as less effective in entrepreneurial education (Béchard & Grégoire, 2005; Láckeus, 2014).

The need of applying digital tools and diverse information sources in entrepreneurial learning has been highlighted lately (see e.g. Scuotto & Morellato, 2013). Utilization of digital learning environments together with classroom instruction is essential for creating authenticity (Guthrie, 2014). This is because development of digital technologies has shaped the whole entrepreneurial process to less bounded, more non-linear and still more unpredictable, at the same time offering new resources, such as digital market places and other infrastructures and limitless information resources (Nambisan, 2017).

3.2 Entrepreneurial education in engineering fields

Technical universities' interest towards pedagogy development for responding to competency-requirements that industries have set in order to acquire qualified workforce, started already in 80's and has continued since (Dym et al., 2005; Felder et al., 2000). During the last couple of decades, universities have begun to use more approaches focusing on active learning, such as project-, problem-, and design-focused courses (Dym et al., 2005; Borrego et al., 2010). For example, team-based design-projects have been introduced to first-year students (Borrego et al., 2010). In line with the recommendations of using experiential approaches in entrepreneurial courses, co-operative and inquiry-based approaches overall are viewed as more efficient for learning than traditional lecture-based knowledge sharing (see Froyd, Wankat & Smith, 2012).

Multidisciplinary project courses are usually focusing either on design (know how) or on solving a certain problem (know why) (Dym et al., 2005). These approaches have several advantages. Project-based courses introduce students concepts of engineering science in early stage of studies, thus getting students better involved into faculty and supporting their intellectual development (Dym et al., 2005; Froyd et al., 2012). In inquiry-based pedagogical solutions, such as problem-, project-, or challenge based learning, students learn concepts through addressing a question and working on it (Froyd et al., 2012). Following, students have possibilities to apply knowledge acquired from previous learning experiences into new situations (Dym et al., 2005; Perrenet, Bouhuijs, & Smits, 2000). Applying problem-based approaches have been suggested into both Bachelor's and Master's degree teaching starting from strictly defined problems, ending to more open ones during later study phase (Perrenet et al., 2000).

In spite of wide awareness of these educational innovations, they are not widely applied and there are still educational institutions that do not apply them at all (Borrego et al., 2010). In addition, applying research on learning, education and behavioral sciences in pedagogical planning and organization of engineering education is still in progress (Froyd et al., 2012). Teacher-centered approach has been especially deep-rooted (Winberg, 2008). These challenges are presented to have three main causes.

First, in research universities developing teaching often has been valued less than doing research (Borrego et al., 2010; Felder et al., 2000). Following, there are not always enough resources for student-centered pedagogics, such as teachers' time, small group size of students, technologies and learning spaces (Borrego et al., 2010). Secondly, the atmosphere for innovative pedagogical trials may be negative, resulting as teachers' lack of power, innovativeness and competencies for developing new solutions (Borrego et al., 2010; Felder et al., 2000). Thirdly, students are not automatically eager to receive pedagogical innovations as integrated part of their everyday life, mainly because applying new approaches may require more independent and active work from them (Felder et al., 2000). Especially students who have recently started their studies could be

motivated by helping them to acquire whole competencies instead of to pass courses with performance-orientation (Kakkonen, 2011).

For solving the challenges presented above, researchers have suggested solutions starting from faculties' innovative course development as their highest priority and to raise valuation of teaching overall (Dym et al., 2005; Felder et al., 2000). Support from university level management in resource allocation is seen as especially important (Borrego et al., 2010). In some universities, for example building spaces especially designed for project-based learning have been supportive resource (Froyd et al., 2012). Borrego et al. (2010) and Dym et al. (2005) view creating disciplinary networks as a possible way to raise teachers' interest towards organizing project-based courses.

As a supportive mean for diffusing novel ideas, researchers suggest that a part of staff members could act as change agents inside universities (Borrego et al., 2010; see also Clavert, 2018). Also co-teaching is suggested to utilize, since it creates strong dynamics to a class, suits well to experiential learning environments, and stimulates students to see different viewpoints and disagreements of teachers (Bouchard, 2007). Overall, previous studies highlight the importance of taking student perspective account in developing new solutions for teaching and learning (Felder et al., 2000). According to Gibb (2005) students have their own personal preferences in the ways they learn. Thus, it is recommended to use flexible strategies to support student to reach learning goals (Gibb, 2005; Hmelo-Silver & Barrows, 2006).

4 Objectives of the study

Entrepreneurship is often viewed to have positive effects on national economics (Egerová et al., 2017; Meyer & Meyer, 2017; Stamboulis & Barlas, 2014). This has resulted as universities' pressures to educate entrepreneurs (Egerová et al., 2017; Lautenschläger & Haase, 2011) and their growing interest towards entrepreneurial education (Blenker et al., 2014; Maritz, 2017; Rideout & Gray, 2013; Sirelkhatim & Gangi, 2015). Since entrepreneurial competencies have been seen to have general relevance also for other than business students, the target group of entrepreneurial courses has expanded to cover students from all disciplines (Boyles & College, 2012; Kucel et al., 2016, Frank, 2007). Previous research of entrepreneurial education has built mainly on two separate directions that have focus either on educational outcomes or on educational process (see Blenker et al., 2014).

This study aims to fill the identified gap between learning outcomes and learning environments and their relationship. Alongside, the viewpoint of previous studies is widened by regarding simultaneously wide selection of formal and informal learning environments instead of analyzing only one course or study program. The first objective is to explore what kinds of entrepreneurial competencies students report to have learnt during studies. The second objective is to identify, in what kinds of learning environments students report to have learnt entrepreneurial competencies. In addition, the third objective is to uncover relations between learning experiences and environments. Thus, the final objective is to reach better understanding of learning entrepreneurial competencies in the context of Aalto University.

Following three research questions are addressed, of which the first has emphasis on learning outcomes and the latter two on learning process:

1) *What kinds of entrepreneurial competencies engineering students report to have learnt during studies?*
2) *In what kinds of learning environments students report to have learnt entrepreneurial competencies?*

3) *Based on students' experiences, what kinds of relations are possible to recognize between learned competencies and learning environments?*

5 Method

5.1 Context

The study was conducted in the context of Aalto University engineering education. Aalto University started operating in 2010 as the merger of the Helsinki School of Economics, Helsinki University of Technology and the University of Art and Design Helsinki (Aalto University, 2018b). This combination was formed to offer more opportunities for innovativeness through stronger interaction between fields of technology, art and business (Aalto University, 2018b).

Aalto University consists of six schools, of which four schools (School of Chemical Engineering, School of Electrical Engineering, School of Engineering and School of Science) provide engineering education (Aalto University, 2018a). These four engineering education schools maintain 13 Bachelor's study programs and 20 Master's study programs (additionally also few international Master's joint programs) (Aalto University, n.d.). The total amount of students in Aalto is around 12 000 (Aalto University, 2019).

Aalto University enables students to access numerous connections to real working life and to entrepreneurship. Special characteristics of Aalto are student-centered orientation, tight relations to industry, startup ecosystem and focus on research (Rissola, Hervás, Slavcheva, & Jonkers, 2017). Several platforms and networks that are founded on both school staff and students have a centric role as facilitators for cooperation of students and companies. For instance, Design Factory is a flexible platform for various cooperative product design functions (see "Preface", 2017). Another example is Aalto Entrepreneurship Society, which is run by students and offers a great variety of activities and possibilities for voluntary work for students who are interested in entrepreneurship (see Aaltoes, n.d.).

Although the entrepreneurial ecosystem of Aalto University as a whole is likely to affect students' learning, the main focus here is on formal entrepreneurial courses and obligatory project courses (see Table 3). There are 47 entrepreneurial courses chosen for review in this study. Part of the courses are especially focused

on the entrepreneurship theme, while another part consists of project courses in other substances. These project courses have attempted to integrate development of entrepreneurial competencies as well.

Table 3.

Entrepreneurial courses

Name	Type (Minor, Module or Course)	Level (B/M)	Number of courses offered	Study credits	Themes and contents
Aaltonaut[a]	Minor	B	12	Minor 25 cr (1 to 10 cr / course)	Interdisciplinary team work, product development, hands-on projects
AVP - Aalto Ventures Program[a]	Minor	M	18	Minor 20 to 25 cr (1 to 10 cr / course)	Different aspects of entrepreneurship
IDBM - International Design Business Management[a]	Minor	M	10	Minor 25 cr (5 to 15 cr / course)	Interdisciplinary team-work, real-life challenges
ME310 – Global Innovation Program	Project course module	M	5	Module 30 cr (5 to 10 cr / course)	Interdisciplinary team-work, product development, internationality, real-life challenges
Protopaja (Protocamp)	Project course	B	1	10 cr	Prototyping, team-work, real-life challenges
Product Development Project	Project course	M	1	10 to 15 cr	Interdisciplinary team-work, product development, real-life challenges

[a]These programs included in total of 12 courses that were accomplished by zero students in the target group.

Most of the chosen entrepreneurial courses have a common emphasis on multi- or interdisciplinary, product development, teamwork and hands-on learning. Several courses also offer an international environment to students. These certain courses were chosen for observation, because they implement the entrepreneurial focus of Aalto University's strategy in practice (see Aalto University, 2015) as they explicitly aim to develop knowledge and skills required in entrepreneur's work. Other criteria for entrepreneurial courses was that all the courses in this category are voluntary to engineering students. In that case, participating an entrepreneurial course was students' own decision.

Namely, the interest is in the courses of three entrepreneurial minor programs, a wide project course module and a pair of voluntary project courses (later this combination is referred as "entrepreneurial courses"). From the three entrepreneurial minors, Aaltonaut is targeted to Bachelor's level students and AVP as well as IDBM were targeted to Master's level. The wide project course module ME310 is directed to Master's level students, concentrating on product development. From the pair of voluntary project courses, which were also included in entrepreneurial courses, Protopaja (Protocamp) is a Bachelor's level workshop course which concentrated on prototyping. Product Development Project is a wide Master's level project course focusing on product development, as its name implies.

Additionally, five Bachelor's level obligatory project courses were taken into account in choosing participants to a reference group (see Table 4). By including both voluntary and obligatory project courses to this study, the purpose was to pay attention to integration of elements of entrepreneurial learning into project courses. This is a current topic in pedagogical development work at Aalto University. These five obligatory project courses are obligatory for students of certain study programs, but none of the courses is obligatory for all engineering students.

Table 4.

Obligatory Bachelor's level project courses

Name	Obligatory to	Study credits	Themes and contents
Sähköpaja (Electricity workshop)	Students in School of Electrical Engineering (except those whose Major is Bioinformation Technology)	8 cr	Fundamentals of electronics, prototyping, group work
SCI-project course	Students in School of Science	10 cr	Interdisciplinary team work, innovation process, team work
ARTS-ENG project	Students in School of Engineering	5 cr	Project management, problem solving, interdisciplinary group work, presentation skills
Software Project 1	Students whose Major is Computer Science, in School of Science	5 cr	Team work, software development project for real client
Software Project 2	Students whose Major is Computer Science, in School of Science	5 cr	Team work, software development project for real client

5.2 Participants

The target group was students whose study right to Bachelor's degree in Aalto University engineering education started on 1.8.2013. At the moment of the research was carried out, the participants were studying in their fifth year. This group was chosen because the fifth-year students had enough courses for observing their whole study path. The researcher got the names of the courses each student had completed, as well as the emails, from Aalto University study register with permission to use the data for research purposes. The total amount of students is 893, of which 881 students had completed courses. Based on the completed courses, four student profiles were recognized (see Figure 5).

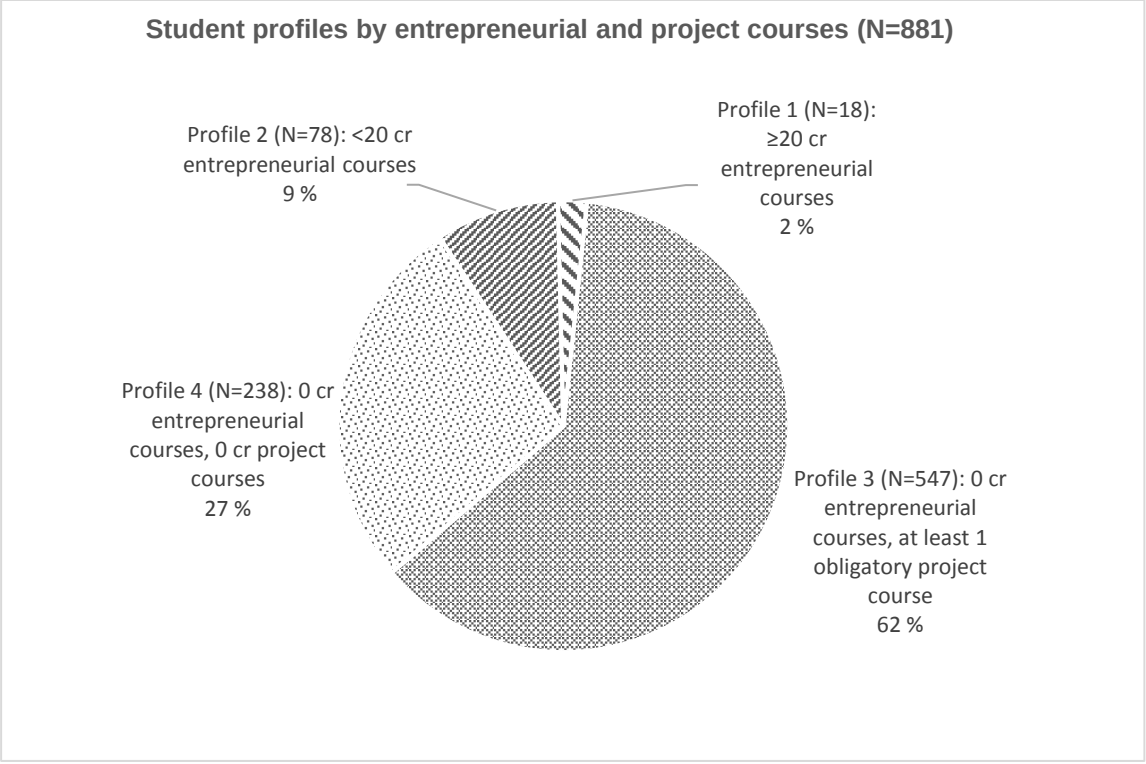

Figure 5. Student profiles by entrepreneurial and project courses

There were 18 students of profile number 1, who had 20 or more study credits from entrepreneurial courses (including voluntary project courses). The profile number 2 included 78 students who had less than 20 credits from entrepreneurial courses. The students of profiles 3 and 4 did not have study credits from entrepreneurial courses. Their total amount was 785, of which 547 students had completed at least one obligatory project course (profile 3) and 238 students had completed neither obligatory nor voluntary project courses (profile 4).

For getting a rich perspective on entrepreneurial courses and project courses, the aim was to interview both students who had taken entrepreneurial courses for 20 or more credits (profile 1 in Figure 5) and students who had not completed entrepreneurial courses (profiles 3 and 4 in Figure 5). These students were approached with research invitation (Appendix 1) via email during April and May 2018. The research invitation was written following the ethical instructions about informing participants (see Finnish Social Science Data Archive, n.d.). Registration for interview was possible through an online form by clicking a link in the email or by answering the researcher's email. As a reward from participation to an interview, volunteers got an umbrella.

Altogether 18 students participated in the interviews. These students represented comprehensively the target group of the research (see Table 5). All four schools of engineering education were present: there were eight participants from School of Engineering, three participants from School of Chemical Technology, six participants from School of Science and one participant from School of Electrical Engineering. Students came from 12 different study programs. Four students had changed study program after Bachelor's level.

Table 5.

Participants

Profile description	Number of participants (*N*=18)	Participant codes
Profile 1: ≥20 cr entrepreneurial courses	7	P1 – P7
Profile 3: 0 cr entrepreneurial courses, at least 1 obligatory project course	7	P8 – P14
Profile 4: 0 cr entrepreneurial courses, 0 cr project courses	4	P15 – P18

The average age of participants was 24,3 years (*SD* = 1,84; *min* = 23; *max* = 30). Eleven participants defined their gender as male and seven as female. Before starting their studies in Aalto, eight students had merely graduated from high school or equivalent. Seven students had performed military or civilian service before starting their studies in addition to graduating from high school or equivalent. Four students had participated in tertiary education in other university or had full-time working experience before studies in Aalto.

Most of the participants (*n* = 12) had worked regularly while studying. Three students had worked occasionally and three students had not worked while studying. Thirteen participants had gathered experience by participating in student association activities or from other network or volunteer work during their studies in Aalto. Eleven of these students had had some sort of role, which included more than average amount of responsibilities, for example as a chairperson of an association or as a member of a board. Four students did not have experience from these kind of activities and one student did not want to answer the question.

5.3 Data collection

5.3.1 Methodological approaches

Since there is a limited number of previous studies about students' experiences of entrepreneurial education, qualitative approach was chosen for getting a better understanding about the phenomenon. Qualitative research is well applicable in situations where little is known about the study object (Leavy, 2014). The goal of using any qualitative method is to gather the perspective of participants and to understand how and why they have ended up to this perspective (King, 2004). Instead of adhering to a one clearly defined direction, the aim was to create the best possible interview frame for answering the research questions. The research instrument built on influences from narrative research, critical incident technique and lifeline approach. In practice, the instrument guided participants to produce narratives about their important (critical) learning experiences with support of lifeline drawing. In this study, words narrative and story are used interchangeably.

Narrative research

Formation of the narrative data collection followed the lines of a previous narrative study by Clavert (2010). Clavert's interview frame was built along the same research directions, although in her study, narratives are seen as a more fundamental research focus. Even though the interview frame here was planned to produce narratives, the interest of this research was not in the stories or in the story structures themselves, but in the contents participants bring up. In other words, the analysis of this research was an analysis of narratives instead of narrative analysis (see Squire et al., 2014). Since narrative research can be viewed as "a loose frame of reference", different positioning of researchers in the field is typical (Heikkinen, 2002, p. 15).

Narratives were considered appropriate for the purposes of producing data about students' experiences for several reasons. First, narratives are possible to observe as external expressions for internal representations of individuals' personal experiences (Squire, Andrews & Tamboukou, 2008). Secondly, as a holistic approach, narrative research takes the complexity of the human nature into account (Webster & Mertova, 2007). Thirdly, in the data collection narrative

approach enables creation of shared interest in participants' experiences (Squire et al., 2014). Participants are aware of researcher's interest in their experiences, which helps creating narratives in the situation. Fourthly, telling stories is a natural way for people to make sense of their personal histories in chronological order (Saldaña, 2011). Overall, encouraging participants to tell their own stories was regarded as a better alternative than asking solely open questions.

Critical incidents technique

Another research direction that influenced this study was critical incidents technique (see Angelides, 2001; Chell, 2004; Flanagan, 1954; Tripp, 2012; Woolsey, 1986). This direction was chosen here to accompany narrative orientation in order to ensure that the participants would not only speak generally about the time of their studies, but also bring up those specific learning experiences that they interpret as important to themselves. This kind of data is required especially for answering the second research question about supportive learning experiences. The words "experience" and "incidents" are used synonymously.

Critical incidents technique has a long history starting from 1950's (Woolsey, 1986). The developer of the method, Flanagan, used critical incidents research during World War II for collecting direct observations of human behavior (Flanagan, 1954; Woolsey, 1986). There are several definitions for critical incident (Angelides, 2001). Originally, the term "incident" referred to "any human activity which is sufficiently complete in itself to permit inferences and predictions to be made about the person performing the act" (Flanagan, 1954, p. 327). The criterion for criticality was that "an incident must occur in a situation where the purpose or intent of the act seems fairly clear to the observer and where its consequences are sufficiently definite to leave little doubt concerning its effects" (Flanagan, 1954, p. 327). Flanagan (1954) proposed critical incident technique as a possible way to attach to learning research.

However, the original definition of critical incident is not applicable in learning (and teaching) research (see Tripp, 2012). The learning events, in which a person later attaches some kind of experience of change, might not seem to be crucial at the time of happening, but is interpreted as turning points after the situation

(Tripp, 2012). To illustrate, in an interview situation a participant might recognize development of some skill related to a certain course, which they did not recognize beforehand. For these reasons, Tripp (2012, p. 8) defined critical incident as “an interpretation of significance of an event”.

According to Tripp’s definition, critical learning incidents were perceived here as situations that participants bring up as important and meaningful for their own learning. Moreover, critical learning incidents of this study might also have qualities of critical events defined by Woods (1993, p. 2), since they were “between the flash-point incidents and career-phase periods”. Students have to take certain courses in their “career”, which are designed to support development of certain competencies. As follows, learning incidents need not to be coincidentally formed in order to meet a definition of critical incident.

Lifeline approach

Thirdly and finally, to support storytelling and systematic recalling of important learning experiences, the lifeline approach (see Assink & Schroots, 2010; Cermák, 2004) was applied. The basic idea of the technique is that participants draw an informal timeline of their life and mark up important experiences to the drawing (Cermák, 2004). This method supports participants to collect personally important experiences from autobiographical memory from a long period of time (Assink & Schroots, 2010) and thus in creation of narrative. For instance, focusing on memories of a whole period of studies could have been a demanding task using only direct questions as a base for narrative. With this solution, participants first get time to draw a lifeline undisturbed without thinking about storytelling at the same time.

5.3.2 Interview frame

The interview frame (Appendix 2) was semi-structured and consisted of three main parts. The first part included two steering questions about working life skills. Asking easy questions first reduces stress and embarrassment (King, 2004). The first question lead participants to the theme by concentrating on skills that they have used in work or in studies during the previous week (see e.g. Strijbos et al.,

2015). The second question set foundation for lifeline drawing by discussing the skills participants consider as important for working life. The idea was that it was easier for the participants to recognize their own development in various situations if they had first thought about working life skills overall. Simultaneously, the question produced data about which skills they perceived important.

The second part of the interview frame was guidance for drawing the lifeline. The participants were advised to pay attention to everything that they experienced as being important for development of their working life competencies. In other words, the purpose was that the participants signified the critical learning incidents by drawing them in the picture. Well-functioning guidance for drawing was adapted from Clavert's Master's thesis (2010) and it was consistent with principles presented in Cermák's (2004) article and in the lifeline method book by Assink and Schroots (2010).

During the third part of the interview, the researcher and the participants went through every incident that was marked in the drawing in a chronological order. For this phase, precise questions were formed to get a profound picture about incidents. The questions related to the importance of the situation, competencies that developed in the situation and situational factors that were experienced as supportive for learning (see Fisher et al., 2008; Lackéus, 2014; Mitchelmore & Rowley, 2010; Schelfhout et al., 2016). The frame included straight questions about knowledge and skills but not about attitudes. To avoid undesirable rationalization of responses, change in attitudes should appear spontaneously in narratives (Jovchelovitch & Bauer, 2000). Accordingly, the aim of this phase was to let the participants to produce their own speech as much as possible.

5.3.3 Interview situations

Since doing pilot interviews is recommendable both for ensuring successful use of the interview frame and method in actual interviews and for developing as a researcher (Atkins & Wallace, 2012), four pilot interviews were made before the actual data collection. The participants of pilot interviews were persons from different backgrounds and age groups. They were well aware of the research

context and commented on structure of interview frame as well as fluency of interview situation. The pilot interviews were recorded for creating a situation as authentic as possible. The researcher used the recordings for observing her own communication style and developing it to support better the participants' answering. In addition, enhancements and modifications to questions were made iteratively based on feedback.

The actual interviews were carried out between April 27 and May 18, 2018 at Otaniemi, in quiet meeting rooms. The language of the interviews was Finnish. At the beginning participants signed a research consent (Appendix 3) and filled a background information form (Appendix 4). The researcher encouraged the participants to ask questions whenever needed during the interview. The structure of the interview situation was introduced in a general level before starting the recording. The participants were also verbally asked a permission to record their speech. Two recorders were used in each situation.

The interview proceeded mainly according to the frame and the questions were presented consistently. At the third part of the interview, the researcher adapted the questions more freely. She followed the answers of the participants and skipped a question if a participant had already answered it. In addition, she asked further questions about certain themes for getting participants to describe their experiences in a more detailed level. Following the guidelines of narrative research tradition (e.g. Jovchelovitch & Bauer, 2000), the researcher did not interrupt storytelling. Besides she encouraged it with gestures and simple expressions. Although the participants were instructed to focus especially on university courses, project works and internships, including all personally important experiences to the lifeline was allowed.

After going through a lifeline, the researcher asked, whether the participants had something to add to the picture drawn. The third part of the interview frame and this question were repeated as long as the participants had no more personally important things to complement. The interview was ended in this phase and the recorder was turned off. After ending the recording, the participants were given a possibility to ask questions freely and tell comments or feedback about the

situation. They were also advised to contact the researcher after the interview, if needed.

5.3.4 Description of data

The total duration of interview recordings was 19 hours and 17 minutes. The times of interviews varied between 46 minutes and 1 hour and 39 minutes. After the interviews, each audio file was named with the participant's anonymous id code, which enabled combining it with the same participant's background information form, and lifeline drawing at the analysis phase. These anonymously named files were sent to the transcription service. Transcriptions were made verbatim in Finnish. The transcribed interviews were in total 389 pages as text files. Any changes to the transcribed text files, for example text wrapping or spelling were not done. Only for the quotations presented in this report, spelling corrections were made. The quotations were translated into English and in some cases also shortened by the researcher.

The structure of the interviews was mainly linear and followed the structure of the interview frame and the participant's lifeline drawing. That is, the students described their learning from a perspective of one situation at a time, starting from the beginning of their studies and ending up to the present situation. Some students returned to certain experiences several times during an interview and expanded their earlier descriptions. Some also began already from times before studies in Aalto, and described for example hobbies and summer jobs from that time. These experiences were excluded from the analysis. Lifeline pictures (Appendix 5) were used as supportive sources for analysis. They were used for example in formation of an overall picture of the data and in checking names of some specific learning contexts that students described verbally. However, the lifeline pictures were not the target of the actual analysis process.

5.4 Analysis

Overview of the analysis is introduced in Figure 6. The general principles of qualitative content analysis (Elo & Kyngäs, 2008; Graneheim & Lundman, 2004) were applied together with abductive reasoning (Tavory & Timmermans, 2014; Timmermans & Tavory, 2012). Abductive analysis made possible creating novel insights into theories of entrepreneurial education, noticing simultaneously both previous theories and special characteristics of the present data (Tavory & Timmermans, 2014; Timmermans & Tavory, 2012). Additionally, for observing relations between experiences and environments, quantification of experiences and learning environments was implemented. This kind of approach is especially useful when a research aims to gain understanding about what was learned in relation to where it was learned (Chi, 1997).

Since analysis phase should be started with a preparation, which is “being immersed in the data” (Elo & Kyngäs, 2008), the transcriptions were first read through several times without taking any notes. The preparation phase continued with writing free-formed notes into the margins of the transcriptions. After familiarization with data, the actual analysis was implemented linearly in the direction of the research questions. More detailed view into the main phases of analysis is presented in the following subchapters.

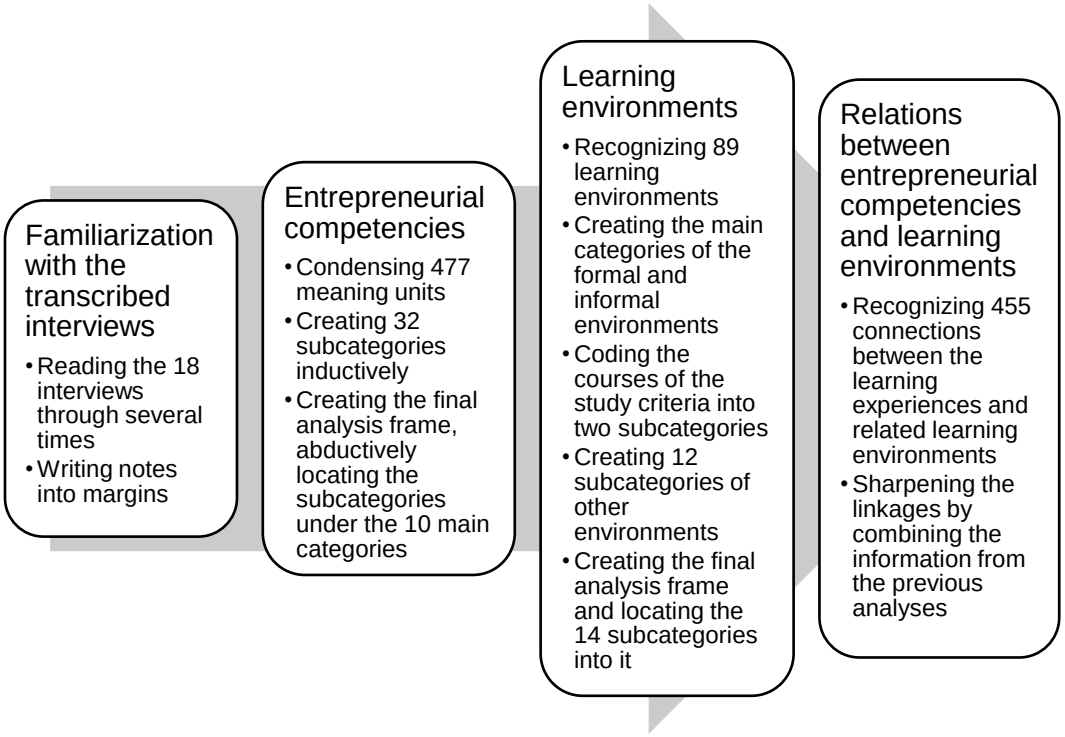

Figure 6. Overview of the analysis

5.4.1 Abductive content analysis of entrepreneurial competencies

In the analysis of entrepreneurial competencies, a meaning unit was chosen as the unit of analysis. More specifically, meaning units were perceived as coherent entities of thought, for example following:

> The lectures were such events that there I got important knowledge about how group pressure affects an individual. (P1)

The criteria for defining a meaning unit was its personal significance to a participant (Tripp, 2012; Woods, 1993). For example, expressions like “there I learned”, “related to this course, I recognize”, “this environment developed”, were used as support for recognizing learning experiences important to participants.

After the recognition of the meaning units from responses, open coding of meaning units was carried out. In practice, condensed meanings of all units were written to margins of transcripts. A condensed meaning was a shortened description of a meaning unit written by the researcher in her own words. For instance, the condensed meaning for the meaning unit introduced above, was

“knowledge about the effects of group pressure”. At this phase, meaning units that were clearly not related to learning entrepreneurial competencies (i.e. “writing CV”) were excluded from analysis.

Next, the open-coded meaning units were collected to three files according to the participant profiles (profiles introduced in Chapter 5.2). After formation of these three files for each profile of participants, the open-coded meaning units were inductively grouped by similar meanings. The grouped meanings were given tentative labels, for example “understanding human behavior”.

Hereafter, in the abstraction phase, the similar categories of the grouped meanings were placed into the same subcategory. For logical formation and naming of the subcategories, the grouped meanings of different participant profiles were also compared with one another. There were subcategories with similar content between the groups as well as subcategories that were unique to a certain student profile. The creation of the analysis frame (see Table 6) utilizing abductive reasoning was closely related to this phase.

Table 6.

Analysis frame of entrepreneurial competencies

Main category	Theory-based definitions	Subcategories
Generic entrepreneurial		
1) Social, collaboration and communication	Interpersonal skills; Seeing other people as a resource; Managing customers; Group/project working; Emphatetic working with others; Offering assistance; Resolving conflicts; Communicating a vision to others; Commitment to own vision but letting go when necessary; Listening, persuasion, written and oral communication	1) Interpersonal skills 2) Seeing other people as a resource 3) Managing customers 4) Group/project working 5) Emphatetic working with others 6) Collaboration 7) Communication
2) Information processing and problem solving	Decision-making; Problem solving (analyzing and developing solutions); Searching, processing and utilizing complex information; Taking risks; Innovativeness and creativeness (creating novel ideas)	8) Problem solving 9) Searching, processing and utilizing complex information
3) Learning and reflection	Orientation towards learning and acquiring new competencies; General ability to learn; Criticality to own contribution; Openess to receive criticism; Ability to reflect own learning; Ability to develop learning strategies based on experiences	10) Orientation towards learning and acquiring new competencies 11) Criticality to own contribution 12) Openess to receive criticism 13) Recognition of own competencies and possibilities to utilize them 14) Reflection of learning 15) Learning strategies
4) Ethical	Acting according to professional ethics; Business ethics (making sustainable decisions)	16) Acting according to professional ethics 17) Business ethics
5) International	Living and acting in a cultural context; Noticing own value-base; International business management (cultural knowledge in i.e. opportunity-recognition and exploiting resources from several markets)	18) Living and acting in a cultural context 19) General cultural knowledge
Entrepreneurship-specific		
6) Opportunity recognition	Seeking and scanning environment; Recognizing opportunities and acting on them; Prototyping and product development; Initiativity	20) Recognizing opportunities and acting on them 21) Prototyping and product development 22) Initiativity
7) Business	Organizing *resources related to technology, finance* (creating business and financial plan; budgeting; obtaining financing; acquiring and developing resources), *human* (hiring; motivating; stimulating action; delegation of tasks; deal-making) *or physical objects*; Strategic competencies (developing strategy; identifying possible strategic partners; defining vision; setting priorities; focusing on goals; planning things ahead; dividing tasks into parts; being flexible)	23) Organizing resources related to finance 24) Marketing and sales 25) Organizing resources related to human 26) Strategic competencies 27) Organizational understanding 28) Bureaucratic understanding
8) Industry-specific	Knowledge about market of the field	29) Knowledge about market of the field
9) Networking	Forming and mantaining networks (knowing people)	30) Forming networks
10) Commitment and perseverance	Self-management (taking responsibility and ownership; managing actions autonomously); Performance-orientation (willing to improve own performance whole the time; high quality-criteria for own work); Endurance and persevarence (tolerance of setbacks)	31) Self-management 32) Tolerance of setbacks

The 10 main categories of the frame based on theories of generic and entrepreneurship-specific competencies (of which theoretical contents were presented in Chapter 2.2). By comparing theory-oriented definitions of the contents of main categories (middle column in Table 6) and inductively formed tentative subcategories, the final subcategories were formed, coded and placed into the frame (right column in Table 6). The abductive phase included continuous revisiting of the phenomenon and alternative casing (see Timmermans & Tavory, 2012), which, in practice was re-formatting the names and checking the contents of categories.

Finally, the total of 477 meaning units were separated into 32 subcategories, of which 19 were located under generic entrepreneurial competencies and 13 subcategories under domain specific entrepreneurial competencies. These categories followed largely the theoretical contents of main categories, although two completely new subcategories of “organizational understanding” and “bureaucratic understanding” were placed under business competencies. The contents of these subcategories were not related to generic entrepreneurial competencies, rather viewed as competencies related to acting in business environments. Knowing how to act with these organization-specific internal and external factors, an entrepreneur is able to form a well-functioning strategy and structures into a firm, thus achieving competitiveness (see Man et al., 2002).

5.4.2 Mixed methods analysis of learning environments and relations between competencies and environments

For answering the second research question about learning environments, the first phase was to recognize, from each group of students, all those learning environments described that were related to experiences of learning entrepreneurial competencies (*N* = 89). Here, the unit of analysis was a name of environment. The students named a few environments unclearly. For example, a student had difficulties to remember the exact name of a course, but gave a course code. In this kind of situations, researcher used the lifeline pictures as supportive tools in reasoning a name of environment as well as Aalto’s web-

based study guides (MyCourses and Oodi). Finally, all the names of the environments were found by utilizing these supportive means.

Creation of the analysis frame (see Table 7) occurred by applying abductive strategy after recognizing names of learning environments. Based on both first impression of the data and theories introduced in Chapter 3.1, it was reasonable to separate two main categories of formal learning environments and informal learning environments. The former includes learning in university context (mainly courses), while the latter focuses on learning that is located in other environments.

Table 7.

Analysis frame of learning environments

Main categories	Subcategories
Formal learning environments	1) Entrepreneurial courses
	2) Obligatory project courses
	3) Focus on substance and tools
	4) Focus on business
	5) Focus on generic competencies
	6) Voluntary project courses
	7) Bachelor's/Master's thesis
Informal learning environments	8) Working during studies
	9) Traineeship
	10) Exchange studies
	11) Participating events
	12) Activities of student association/voluntary work
	13) Military/civilian service
	14) Personal experiences and hobbies

From formal learning environments, coding started from utilizing study criteria presented in Tables 3 and 4. The subcategory of “entrepreneurial courses”, included courses from Aaltonaut, International Design Business Management and Product Development Project. Students did not describe other entrepreneurial courses from the study criteria. The subcategory of “obligatory project courses” included descriptions of only two courses from the study criteria: ARTS-ENG- and SCI-projects.

The formal learning environments that student described but were not included into study criteria, were coded under the subcategories of “focus on substance and tools”, “focus on business”, “focus on generic competencies”, “voluntary project courses”, and “Bachelor’s/Master’s thesis”. The first four categories were formed based on aims and type of courses. Here, Aalto’s study guides were used again as a supportive resource. The last category of “Bachelor’s/Master’s thesis” was included in course environments, since writing thesis and attending thesis meetings or seminars were considered as part of formal education.

Informal learning environments were categorized inductively by first grouping similar environments and then abstracting these groups of similar environments into subcategories, which were named according to the contents. Even though, for example traineeships and exchange studies were organized (at least loosely) in the context of formal education, these environments were assumed to have more elements of informal and holistic learning than actual course contexts (see Tynjälä, 2008). Therefore, they were placed under the main category of informal learning environments. Also participation of events and activities of student associations often happened in the university environment. However, the students usually participated in these activities voluntarily in their free time and university was not the official organizer, despite of it might provide its facilities for use.

After recognizing and categorizing the environments, they were coded consistently according to the analysis frame, under the proper sub- and main categories. In this phase, in order to ensure the uniformity of classification, the environments of each group of students that were analyzed earlier separately, were also compared to each other. Simultaneously, for finding possible

environmental emphasizes in learning, numerical information was analyzed about how many significant learning experiences were related to each learning environment. It was also ensured that environments not related to experiences of learning entrepreneurial competencies, were not included in results.

Since participants did not always clearly indicate the names of the environments attached to their learning experiences, the researcher should recognize linkages by reading the transcriptions and using the lifelines as support for observing the big picture of answers. The final sum of observed linkages (*N* = 455) differed from the total amount of learning experiences (*N* = 477). This was because from all formed linkages (*N* = 494), those that were not related to clear contexts but described as “time of my Bachelor’s studies” or “whole time during studies” (*n* = 39), were excluded. Still, some experiences related simultaneously to several (two or three) clearly defined environments were included into this analysis phase.

Lastly, for answering the third research question, the linkages between learning experiences and environments were re-examined and sharpened to cover also information about what kind of competencies were recognized as learned in certain environments. In other words, the meaning units of entrepreneurial competencies already analyzed for answering the first question and environmental information for answering the second question, were combined. This was done first separately for each group of students and then combining information of all students. The result was a table that described frequencies of linkages between main categories of entrepreneurial competencies (rows) and categorized learning environments (columns).

6 Results

The first research question was addressed as w*hat kinds of entrepreneurial competencies engineering students report to have learnt during studies.* The participants had in total 477 mentions of learning entrepreneurial competencies. Distribution of these mentions was fairly even between categories of generic entrepreneurial competencies (252 / 52.8 %) and entrepreneurship-specific competencies (225 / 47.2 %). The number of generic entrepreneurial competencies was only slightly larger than the number of entrepreneurship-specific competencies. In Table 8, main categories of entrepreneurial competencies are displayed by frequencies and percentages of participants' mentions.

Of generic entrepreneurial competencies, social, communication and collaboration competencies (150 / 31.4 %) were mentioned most often. In addition, information processing and problem solving (47 / 9.9 %) and learning and reflection (39 / 8.2 %) were mentioned moderately. International (14 / 2.9 %) and ethical (2 / 0.4 %) competencies were mentioned rarely.

From entrepreneurship-specific competencies, the most usual were business competencies (115 / 24.1 %). Commitment and perseverance (58 / 12.2 %) and opportunity recognition competencies (32 / 6.7 %) appeared moderately. Weights of industry-specific competencies (13 / 2.7 %) and networking competencies (7 / 1.5 %) were low.

Table 8.

Learned entrepreneurial competencies of all students

	Main category	*f*[a]	%[b]
Generic	Social, communication and collaboration	150	31,4 %
	Information processing and problem solving	47	9,9 %
	Learning and reflection	39	8,2 %
	International	14	2,9 %
	Ethical	2	0,4 %
Entrepreneurship-specific	Business	115	24,1 %
	Commitment and perseverance	58	12,2 %
	Opportunity recognition	32	6,7 %
	Industry-specific	13	2,7 %
	Networking	7	1,5 %
	Σ	477	100 %

[a]Frequencies of all experiences [b]Percentages of all experiences

In the following subchapters, experiences of learning are explained more precisely, starting with generic entrepreneurial competencies and proceeding to entrepreneurship-specific competencies.

6.1 Generic entrepreneurial competencies

Social, communication and collaboration

The meanings given to learning social, communication and collaboration competencies (150) were primarily related to *communication* (53). Experiences of learning *group and project working* were almost as typical (40). *Seeing other people as a resource* (20), *interpersonal skills* (16) and *collaboration skills* (12) came up moderately. In a few experiences, learning of *managing customers* (5) and *empathetic working with others* (4) were described as well.

The experiences of learning *communication* were often related to oral communication, which was giving presentations either in native or in foreign language and development of language skills.

> In practice, I got very much practice in presentations and how to keep a good one. Not only to speak in front of people but also to build good communication. Maybe communication has the key role there, in addition to presentation skills and confidence (P6, ≥*20 cr entrepreneurial courses*).

> Learned English and such. (P9, *0 cr entrepreneurial courses, at least 1 obligatory project course*)

Also written and visual communication came up. Written communication was described from the perspective of academic writing. Visual communication came up, in turn, for example editing videos and to adopt a more visual style of communication overall.

> […] writing papers. For example, making Bachelor's thesis or similar reports in physics laboratory courses. They have been quite educational experiences, just to mention. Sometimes it is very challenging to get things on paper, although I would know what to do, but still writing can be difficult. […] It is good that these skills are practiced during studies. (P8, *0 cr entrepreneurial courses, at least 1 obligatory project course*)

> […] but I got to edit videos, which can be useful sometimes in the future. (P2, ≥*20 cr entrepreneurial courses*)

> Overall, more esthetical way of thinking in many things. And sort of a different way to present your own work (P4, *20 ≥ cr entrepreneurial courses*).

Some experiences focused also on communication about person's own field, or communication more generally. In the following, a participant highlights learning about the importance of clear communication between people from different academic backgrounds:

> It was just working with people from different backgrounds, and there I noticed, how important it is to clarify ideas very thoroughly because, for example students from ARTS do not have same background information. There I noticed that I usually explained terribly much and then they asked, what does this mean and whether some lever should be placed here, and such. (P3, ≥*20 cr entrepreneurial courses*)

Learning of *group and project working* competencies were often mentioned in general. These descriptions included general learning about working in groups and project working co-operationally with other students.

> Well, maybe group working slash project working, which is one thing that we begin in a group and then get it done and then it ends. (P6, ≥*20 cr entrepreneurial courses*)

> Yes, then I have my minor, Aaltonaut at Design Factory. Well… there my group working skills deepened. (P1, ≥*20 cr entrepreneurial courses*)

Learning about group dynamics and social roles were also essential related to group and project working. Participants described both finding their roles in a group and understanding different roles and relations between them. They recognized the role of team spirit and importance of creating it during working in a group. They also had experiences of getting readiness to take group dynamics into account in their own working. The following learning experience was related to well-functioned group working during a course:

> Well, there I at least noticed, where good spirit in a group can lead that all were inspired about the product. And all the time we spoke with each other that this will be a very good thing. And there I recognized that it supported us to proceed. Compared to a situation, where everyone gets tasks and then they do them and don't speak any more, or anything. (P8, *0 cr entrepreneurial courses, at least 1 obligatory project course*)

In addition to the themes presented above, a few experiences focused on group and project working from the perspectives of co-learning, giving feedback and problem solving in a group. Also, self-organization of group working and multiculturalism of the group were brought up as minor themes.

Seeing other people as a resource was in particular learning to perceive interdisciplinary as a resource. Participants mentioned to have learnt appreciation and respect towards other disciplines and got used to how other people worked. They experienced to have learned utilizing group's diverse competencies and to perceive interdisciplinary working as important to themselves.

> […] then it came out more strongly that how co-operation between technical and business and design was needful and also that it is obligatory especially when talking about product development, service development or suchlike. Or when talking about anything. Not only about developing something but also when talking about working life more generally. Well, I can imagine that very rare jobs are possible to do by not discussing with anyone. Or by discussing only with people of same expertise. (P6, ≥*20 cr entrepreneurial courses*)

Related to seeing other people as a resource, participants also described that they learned to ask help from others and to recognize others' competencies or mindsets. They got more courage to ask help and were better able to recognize a potential helper, such as a peer or a supervisor.

> We were able to complement each other. As it is, during the whole process, I learned that there is always someone, who is good at a certain thing. That this person should be asked for help. (P12, *0 cr entrepreneurial courses, at least 1 obligatory project course*)

> Well, at least if there is a larger group of people, it is possible to recognize such. That someone can especially use some device or knows everything about it. Even though, this person was not your supervisor, or something, they can be a very important person in that thing. And they can always be asked about things, just because they just happen to know much about that thing. (P8, *0 cr entrepreneurial courses, at least 1 obligatory project course*)

Learning *interpersonal skills* included social skills, understanding human behavior and courage to participate in social action. Learning social skills was described as general understanding how to be, work, co-operate and communicate with others. Understanding human behavior was related to learning behavioral models that people usually tend to have both alone and in groups. Courage to participate in social action was described in one learning experience and it referred to getting more courage to challenge the limits of comfort zone.

> And there also, I think that I learned very much about other persons' work and how I should react to that or how I should be with others and what kinds of different scenarios there are. (P14, *0 cr entrepreneurial courses, at least 1 obligatory project course*)

> […] lectures were important events that gave important knowledge for example about how group pressure affects an individual, and such that. (P1, *≥20 cr entrepreneurial courses*)

> […] Well concretely, what I learned there was to have courage to participate and to explore outside of own bubble. And what others do and why they do and how this is related to my own doing. (P17, *0 cr entrepreneurial courses, 0 cr project courses)*

Participants described learning of *collaboration* competencies in the context of workplace and as collaboration with many different parties. In the workplace context, the emphasis was on how to work as an employee and participate meetings. Additionally, learning of collaboration competencies was described in the university environment, where it was related for example to Master's thesis process.

> […] I learned more about meeting practices. (P15, *0 cr entrepreneurial courses, 0 cr project courses*)

> And then also communication between the instructor and professor and me. (P1, *≥20 cr entrepreneurial courses*)

A few mentions about learning of *managing customers* were also presented. These mentions dealt about learning customer service and communication to customers.

> […] I have learned most about people. That how clients, each client is different. How I should face them. What I should think there to create them the best possible experience. (P18, *0 cr entrepreneurial courses, 0 cr project courses*)

Finally, *empathetic working with others* was described through being competent to observe needs of others', behaving empathetically and to get along with everybody.

> And to be able to take these other people into account and that, is it empathy - that is able to understand others why they do as they do and what kind of needs they have in the project. […] (P6, ≥*20 cr entrepreneurial courses*)

Information processing and problem solving

Learning experiences of information processing and problem solving competencies (47) were related to *searching, processing and utilizing complex information* (40). *Problem solving* was mentioned rarely (7).

Participants described to have learned searching information utilizing tools and systems of their own domain. Into this theme, they related skills of applying previously acquired knowledge, adopting new information quickly, working with large entities of information and learning value of research as a base for own action.

> […] we went through databases, where it is possible to find these […] I also learned to use tools that definitely are possible to apply in working life for searching some information needed. (P18, *0 cr entrepreneurial courses, 0 cr project courses*)

> That I can now perceive big entities quickly and to understand, how things are related […] (P12, *0 cr entrepreneurial courses, at least 1 obligatory project course*)

> I guess that as new skills I understood the value of frameworks and literature. That first time I thought that it is clever to not only work by following gut feeling but that there is a huge amount of research […] (P10, *0 cr entrepreneurial courses, at least 1 obligatory project course*)

Learning to work with "real data" and presenting information in forms more easily to interpret also appeared in experiences.

> […] I have found that especially in so-called real life, data are usually terrible and difficult to find and it is likely that you cannot make any conclusions about them after all […] I have also learned this kind of dealing with real data. (P12, *0 cr entrepreneurial courses, at least 1 obligatory project course*)

> […] especially when there are much data, […] how they are visualized, so that corporate management or some other direction for whom they are produced, well there I found fundamental things that were immediately possible to utilize in my own action […] (P10, *0 cr entrepreneurial courses, at least 1 obligatory project course*)

In addition to information processing, searching and utilizing competencies, participants brought up to have learned recognizing and solving problems.

> […] I learned to recognize, what kinds of problems are typically emerging. (P4, ≥*20 cr entrepreneurial courses*)

> […] there was just problem solving that I don't know if I learned that much, but at least I had a possibility to try, and kind of, if I first got an idea about implementation of an idea and it does not work, then I can try something else until I find something that works. (P2, ≥*20 cr entrepreneurial courses*)

Learning and reflection

Learning and reflection competencies (39) were firstly described as *orientation towards learning and acquiring new competencies* (15) and *recognition of own competencies and possibilities to utilize them* (15). Secondly, they were seen as development of *learning strategies* (5). Also single learning experiences concerning *reflection of learning* (2), *criticality to own contribution* (1) and *openness to receive criticism* (1) were included.

Participants observed *orientation towards learning and acquiring new competencies* as recognition of own interests, motivation and ability to learn. They described topics they would like to learn in the future. Some of them described recognition of own interests and motivation to learn that developed in other than their major studies, for example in art or product development courses, in which they had directed their study paths. Participants also recognized learning to trust their own capability to learn complex things quickly and to develop their competencies according to needs of working life.

> It is very nice to be interested and I can choose or I have more options between courses and I can read whatever I want, in principle. Therefore, during Master's degree phase, I have understood that no one plans things for you, but you have to think about your own interests yourself, about what you want to do and what

> kind of information you would like to have more. So, in this way those things are related to each other. (P5, ≥*20 cr entrepreneurial courses*)

> Even though, you can do nothing already, it is possible to learn in couple of days. (P3, ≥*20 cr entrepreneurial courses*)

> […] I have learned to maneuver learning according to what could seem good in the context of working life and trying to observe, what kind of needs there are in working life in the future […] (P15, *0 cr entrepreneurial courses, 0 cr project courses*)

Experiences of learning *to recognize own competencies and possibilities to utilize them* included understanding possibilities for applying competencies in practice, in the contexts of academic and working life. Typically, these descriptions were concentrating to applying theory into practice and situations, where participants' own learning became evident. They were often related with recognizing own strengths and targets for personal development.

> One of the biggest things I learned was that research made in academic world can be attached to the real world and to learn from it – with some caution, but I think it was a very useful thing to learn. (P10, *0 cr entrepreneurial courses, at least 1 obligatory project course*)

> And to see that actually these things that I have handled up to this point, they are similar by this way. And it is really cool, and it is of course possible to utilize in the future. (P4, ≥*20 cr entrepreneurial courses*)

> Gradually you are going to perceive your own strengths. And how to utilize them in working life. (P7, ≥*20 cr entrepreneurial courses*)

Students viewed learning of *learning strategies* both as development of ability of learning to learn, which included management of own learning process, and prioritizing learning to essential things, as in the following:

> […] learns to analyze own interests and, kind of, to understand better – or let's say that this kind of model about a skeleton of information is describing, so that if it is possible to build the skeleton, then it is easy to put the muscles on it. (P10, *0 cr entrepreneurial courses, at least 1 obligatory project course*)

> Just to know, what is essential. When so huge amount of information is coming, just to know that okay, this is not directly related to this. That it is not fatal, even though, I don't understand this stuff. But, I can concentrate on this instead. (P11, *0 cr entrepreneurial courses, at least 1 obligatory project course*)

The single experiences of reflection of learning, *criticality to own contribution* and *openness to receive criticism* covered meanings of recognizing themselves as a

learner, to challenge themselves to seek better ways of working, and preparedness to receive external critique and learn from it.

> Kind of an analytical way to think […] that can systematically seek solutions to problems, or to think, what went well and what went poorly, where are the possible targets for development and is able to think how […] in the future […]. (P4, ≥*20 cr entrepreneurial courses*)

> It was a kind of learning experience. Despite the critique that focused for example on charts we had done, was not actually good, it was also given in extremely unfriendly way. So, I perceived that in working life, I will certainly face these kinds of people, so it is better to learn to deal with it now already. (P15, *0 cr entrepreneurial courses, 0 cr project courses*)

International

Learning international competencies were described (14) from perspectives of *living and acting in a cultural context* (8) and *general cultural knowledge* (6).

First, learning to *live and act in a cultural context* included descriptions of learning internationality and international cooperation in general, as in the following:

> […] and also internationality. International skills. (P18, *0 cr entrepreneurial courses, 0 cr project courses*)

> […] there is also international action, which is, of course depending on the firm, useful in the working life, I would say it has been really useful. (P12, *0 cr entrepreneurial courses, at least 1 obligatory project course*)

Also learning how to work abroad and business traveling as well as orientation to new cultures were brought up. As indicated in the quotations, this included meanings of getting used to working in new environments, readiness to work abroad and the ability to adapt new environments generally.

> […] Though, it is a new environment and only for a short time, it requires working normally, so I learned there that working in practice happens similarly there than they would happen here. It is just a different environment. (P6, ≥*20 cr entrepreneurial courses*)

> Well, I could still think about traveling for work, it gave me sort of more preparedness for it. So I would not see any problem to work abroad. (P4, ≥*20 cr entrepreneurial courses*)

> Also living in a new culture, so it is kind of adapting to different environments and people and cultures, of course it was also that kind of a thing. (P5, ≥*20 cr entrepreneurial courses*)

Learning *general cultural knowledge* was learning about other cultures and their typical ways to act. Participants viewed cultural knowledge as essential for making business, as well.

> […] just, sort of operating between cultures, that kind of thing I learned there very much. […] Kind of acting with different types of cultures […] (P12, *0 cr entrepreneurial courses, at least 1 obligatory project course*)

> There I learned much about different cultures. Before we chose the one market to focus on, we had to research for doing the choice so – Had to research why we should focus on a certain area, so it became evident that cultural knowledge is important – in a multinational company. (P6, ≥*20 cr entrepreneurial courses*)

Ethical

Learning ethical competencies (2) was seldom mentioned. One mention was related to *acting according to professional ethics* (1). A participant described "unwritten rules" of professional ethics. The other mention was about *business ethics* (1), more specifically environmental issues in product development.

> […] when speaking about consult ethics in the context of working life, although there were no confidentiality agreements signed, everyone participating discussion understands what kind of rules are used there and which things are off the record. So, in some ways, at the lectures I had a feeling that this guy wouldn't want me to give any statement to the newspaper about this. Even though, it was not anyone's intention, but I mean, it was attending discussion that felt exciting and dealt with right things, and we are really thinking, and now it is possible to ask. (P10, *0 cr entrepreneurial courses, at least 1 obligatory project course*)

> […] we had product sustainability course, where we went through, which things are good for nature. (P5, ≥*20 cr entrepreneurial courses*)

6.2 Entrepreneurship-specific competencies

Business

Of business competencies (115), the most frequently emerged descriptions were related to learning of *strategic competencies* (37), *organizing resources related to human* (25) and *organizational understanding* (24). Besides, learning of *marketing and selling* (13), *organizing resources related to finance* (9) and *bureaucratic understanding* (7) were presented.

The vast majority of learning experiences related to *strategic competencies* included descriptions of learning how to plan and divide projects into parts. More precisely, this included learning to plan schedules, set goals, share the workload, recognize causal relationships, understand the working process and make processes more efficient.

> It is certainly kind of planning, which is always when there is a large project and no information about what we are going to do at the beginning. Still, you must be able to do the plan for the whole project. (P6, ≥*20 cr entrepreneurial courses*)

> Well. Causal relations about what happens if someone is late and so on. (P1, ≥*20 cr entrepreneurial courses*)

> Understanding the process model and modelling everything in the form of a project. (P13, *0 cr entrepreneurial courses, at least 1 obligatory project course*)

In a few experiences, learning strategic competencies was seen as learning basics of creating and running a business. These competencies were related to founding a venture, making a business plan and to expertise needed in different phases of a company's life cycle.

> […] through practical making we learned to take care of, how entr- what is related to establishment of a company, what is a business plan […] (P10, *0 cr entrepreneurial courses, at least 1 obligatory project course*)

> […] yes, I experience that I have a better understanding of what is required in running a venture and how it is possible to make it profitable. […] (P16, *0 cr entrepreneurial courses, 0 cr project courses*)

Also, learning to set priorities and to be flexible, related to strategic competencies, were mentioned by a small minority of participants. These participants viewed setting priorities essential in focusing resources towards the most important goals. Flexibility was seen as prerequisite for adapting to continuous changes common in the project work.

> If the results must be achieved, or if something to be presented should be got ready, it can be that there is a need to take a shortcut in some phase and so on. (P2, ≥*20 cr entrepreneurial courses*)

> Well, actually we had for example the original plan that went a little bit wrong and therefore we had to change direction in the middle of everything. So it was, oh well yes, this can also happen. So I had to change the way of thinking about the project. It opened my eyes that well okay, projects are not always proceeding as planned, and it just needs to be accepted, and some kind of solution should be developed. (P5, ≥*20 cr entrepreneurial courses*)

Experiences related to learning *organizing resources related to human* were often leadership-themed. They described learning about leadership overall, as well as related to making decisions and getting people to work towards goals so that they still have fun.

> […] there I had my own committee, so it was about how it should be led […] (P12, *0 cr entrepreneurial courses, at least 1 obligatory project course*)
>
> […] and what kinds of decisions should be made if some day you work as a leader, or something important that should be remembered. (P5, *≥20 cr entrepreneurial courses*)
>
> Well, there I thought and philosophized much on that issue. About how everyone has a good time and simultaneously how to get results. (P18, *0 cr entrepreneurial courses, 0 cr project courses*)

Learning organizing resources related to human came out also in meanings of delegation of tasks. These descriptions focused both on learning how to delegate tasks fairly and how to utilize team members' different areas of expertise.

> […] to share the workload. What each person should do […] (P8, *0 cr entrepreneurial courses, at least 1 obligatory project course*)
>
> Maybe mainly this kind of… not everyone is required to do exactly the same amount of work in those group works. That it does not necessarily bring any more value, if someone has no motivation or expertise. (P12, *0 cr entrepreneurial courses, at least 1 obligatory project course*)

Still, related to organizing resources related to human, couple of participants described learning negotiating and finding compromises. Finally, there was a single mention about stimulating action, which dealt with supporting learning of other participants in a group or team.

> […] I learned some negotiating skills […] (P11, *0 cr entrepreneurial courses, at least 1 obligatory project course*)
>
> […] to hear others opinions and to find some compromise […] (P9, *0 cr entrepreneurial courses, at least 1 obligatory project course*)
>
> And that they [members of the group led] view to have accomplished something and to have learned. (P14, *0 cr entrepreneurial courses, at least 1 obligatory project course*)

Learning *organizational understanding* was described referring to organizational functions as well as organizational structures. More accurate, this was seen as getting an understanding of organizations' overall functioning and structures. Additionally, learning about single organizational functions was discussed. These

meanings related mostly to understanding of organizing well-being and security, enabling social interaction and communication in organization. Also the value chain of organization bound to organizational structures was mentioned.

> […] and then also some… this kind of… how the organization works or. (P1, ≥*20 cr entrepreneurial courses*)

> There was one that I remember, which was the value chain. I had to analyze, what this working place produces, what value it creates. And just to analyze what raw materials it takes in, how they are processed, where the value is growing into them. And it was really interesting, I think, because it was entirely a new perspective into that. […] It gave me really new perspectives. (P17, *0 cr entrepreneurial courses, 0 cr project courses*)

From meanings of learning *marketing and sales,* learning about marketing included creating images, being able to "polish" own work and to overall understand communication that aims to affect customers. Learning sales was described as learning how to sell products and ideas. A centric theme related to selling own ideas was learning to pitch.

> How to create images about things to people. (P6, ≥*20 cr entrepreneurial courses*)

> Of course, I learned to understand when I see advertising, what is sought there and what is the importance of a brand, and for example its signature colors and so on, all communications. (P13, *0 cr entrepreneurial courses, at least 1 obligatory project course*)

> And how to sell things. (P6, ≥*20 cr entrepreneurial courses*)

> And to just understand, how pitching of product to others should be done. (P3, ≥*20 cr entrepreneurial courses*)

Learning *organizing resources related to finance* was seen as learning about financial management in general, such as developing skills for accounting and making different calculations. Participants also described learning to obtain financing, understanding acquisitions and invoicing and getting perspective into efficient money spending.

> And that kind of money calculations, discounting and those kind of things, for estimating, how much funds we need in order to start this process. (P15, *0 cr entrepreneurial courses, 0 cr project courses*)

> And then, I have applied sponsoring. It has given much, I think I learned to call and seek sponsors and what should be thought then for getting sponsoring. (P14, *0 cr entrepreneurial courses, at least 1 obligatory project course*)

> Efficiency of spending money and there I learned, even though I speak kind of different thing, of course you will learn to view economy sharper and to plan

> money spending. (P13, *0 cr entrepreneurial courses, at least 1 obligatory project course*)

Lastly, learning *bureaucratic understanding* was described as developed understanding of bureaucratic processes and skills for dealing with bureaucratic issues and tasks.

> I would say that kind of administrative and bureaucratic understanding and producing that kind of text myself. Such that I can read for example financial statements and action reports without problems. I understand their subject matters and value and this sort of things […] (P12, *0 cr entrepreneurial courses, at least 1 obligatory project course*)

Commitment and perseverance

Learning commitment and perseverance was brought up through themes of learning *self-management* (44) and *tolerance of setbacks* (14). Learning *self-management* was described most often as learning to manage actions autonomously. These descriptions included learning to organize own working overall, to work autonomously, to manage using time and to set boundaries for own work.

> Maybe more independent working. There were a couple of check points, where I had to return and to get feedback, but otherwise I had to think alone, what I do, when and how. And then I had just to motivate myself […] (P3, ≥*20 cr entrepreneurial courses*)

> Of course, I have learned about managing my own time, planning it. (P12, *0 cr entrepreneurial courses, at least 1 obligatory project course*)

> And maybe I learned to set boundaries for my own work during that course. (P11, *0 cr entrepreneurial courses, at least 1 obligatory project course*)

Learning self-management was also related to taking responsibility and ownership. These experiences were related to taking responsibility of the whole work process and developing a persistent, patient and precise way of working.

> I would say that most important was productivity. No one looks after you, if you have really done. You necessarily cannot do any measurable things during the day. So, such learning that you can't just be in Facebook the whole day or I don't know what else I could have been doing there. If you want to get things ready, you just have to work. And no one counts the hours. (P12, *0 cr entrepreneurial courses, at least 1 obligatory project course*)

> Well, at least not to give up immediately if you do not understand something. It is such an important thing, just to try a little bit more. (P5, ≥*20 cr entrepreneurial courses*)

Learning *tolerance of setbacks* was described mainly as developed tolerance for stress, inconvenience and uncertainty. Participants observed learning to understand that uncertainty is part of working process and that way learned working with it. They also viewed learning of distancing themselves from stressing things by taking more a relaxed attitude.

> Well, that way tolerance of uncertainty and then understanding that uncertainty instead of only tolerating it. To understand that uncertainty does not have so large meaning as you would first think it has. Yes, it is for me – there it has became as significant to me. (P6, ≥*20 cr entrepreneurial courses*)

> Just kind of, tolerance of stress and kind of, some way I can think that this is not so serious in the end. (P12, *0 cr entrepreneurial courses, at least 1 obligatory project course*)

Still, related to tolerance of setbacks, couple of experiences included descripted development of self-confidence in coping with difficult situations. Additionally, one participant had experience of learning to change their own attitude towards failing.

> […] and it has always given me kind of self-confidence and trust, and I have dealt with many kinds of difficulties […] And well, certain kind of, I kind of enjoy solving difficult problems in new environments. So maybe I can conclude that I have got the skills needed in working life, such as self-confidence for different kinds of situations. (P4, ≥*20 cr entrepreneurial courses*)

> And I made some mistakes, so it was not, it was not actually so bad, and. (P1, ≥*20 cr entrepreneurial courses*)

Opportunity recognition

Mentions of learning opportunity recognition competencies (32) were related to *prototyping and product development* (24), *recognizing opportunities and acting on them* (4) and *initiativity* (4).

First, learning *prototyping and product development* was typically related to understanding the product development process, learning tools of thinking for developing product ideas as well as manufacturing techniques related to prototyping and product development.

> Of course the expertise of product development, technical expertise, all that is related to product development process and – How product development can be done and so on. Technical skills in practice alongside these other things. (P6, ≥*20 cr entrepreneurial courses*)

> There was much about processes, how brainstorming should be done, different techniques. There were all kinds of useful information. […] (P3, ≥*20 cr entrepreneurial courses*)

> Yes, I have to say that if I think that I now founded a startup, there I learned 3D printing – the basics of it and then about different techniques and devices. (P7, ≥*20 cr entrepreneurial courses*)

Further, related to learning prototyping and product development, a few mentions concentrated on understanding value formation of products or services and understanding product development chain. A couple of responses also included learning commercialization of products or services and getting general understanding of product development process.

> How the value of product is formed, why it is formed, why customers value brands, what is a brand. (P6, ≥*20 cr entrepreneurial courses*)

> I learned a lot about product development chain and supply chain management things, about how it works […] (P13, *0 cr entrepreneurial courses, at least 1 obligatory project course*)

Participants described learning of *recognizing opportunities and acting on them* as understanding customers' needs, opportunity recognition and developing business ideas. They experienced learning of understanding customer's needs as supportive for planning product or service and developing business ideas.

> […] the idea was to create some product, which we could possibly sell in future. So we got thoughts about how customers really act […] (P8, *0 cr entrepreneurial courses, at least 1 obligatory project course*)

> It was, I saw that there is a need for this kind of new service or business model. (P7, ≥*20 cr entrepreneurial courses*)

> […] We had to think business ideas about what companies could be placed there. And we got quite well the big picture of it. (P9, *0 cr entrepreneurial courses, at least 1 obligatory project course*)

Learning *initiativity* came out in experiences mainly as courage to face new things and situations. More specifically, it was seen as self-confidence to participate new situations or seek new environments. In one experience a participant described development of actual entrepreneurial intention. This participant had got a clear vision of founding a firm.

> […] From zero base, I had to jump to a challenging level, and there I had to change my own, had to indulge myself, had to change my way of thinking strongly. And overall, skill to absorb new things and sort of ability to indulge myself in situation […] (P4, ≥*20 cr entrepreneurial courses*)

> In the beginning of Master's studies, I already targeted founding my own start up at the end phase of the Master's studies or during the Master's thesis process. (P7, ≥*20 cr entrepreneurial courses*)

Industry-specific

Learning industry-specific competencies (13) was described as developed *knowledge about market of the field* (13). This was related to getting a whole picture of own field and its functions as well as learning to recognize special characteristics of different fields.

> Well. To understand about how [name of a specific field] works and. (P1, ≥*20 cr entrepreneurial courses*)
>
> And then I learned, kind of, how the business is built. (P7, ≥*20 cr entrepreneurial courses*)
>
> […] I recognized that industries are very different compared to each other […] (P10, *0 cr entrepreneurial courses, at least 1 obligatory project course*)

Networking

Participants described learning networking (7) more specifically as developing in *forming networks* (7). This included getting expertise for networking with peers and actors of own field. Additionally, participants experienced to learn, what kind of role networking has.

> It represents this kind of networking, it is important to learn to know people and also different people, also from outside of courses so that there are different fields present. […] I would say, it was an important thing that I have learned. (P12, *0 cr entrepreneurial courses, at least 1 obligatory project course*)

6.3 Learning environments

The second research question focused on *in what kinds of learning environments students report to have learned entrepreneurial competencies.* Learning experiences were related both to formal and to informal learning environments. The number of relations to formal environments was somewhat larger (263 / 57.8 %) than to informal environments (192 / 42.2 %).

Starting with formal learning environments, entrepreneurial courses holds more learning experiences (66) than the other formal environments (see Figure 7). Emphasis of experiences was on certain courses of Bachelor's and Master's level entrepreneurial study programs. According to participants' descriptions, these courses were international and interdisciplinary with focus on problem solving in groups. Participants experienced to had got hands-on experiences on entrepreneurial issues as well as possibilities to be in touch with real companies.

> […] then I found Aaltonaut minor program, which was about product development. Almost all courses were group works, where we had engineers and students from Schools of Business and Arts. There we did projects and thought different phases of product development process. […] It was different and fun. Group works were successful there. (P3, ≥*20 cr entrepreneurial courses*)

> […] there were lots of students from elsewhere, so I got to speak English. (P5, ≥*20 cr entrepreneurial courses*)

> […] occasionally on the courses some companies came to offer us viewpoints and in some course we were at study excursion in some company. (P2, ≥*20 cr entrepreneurial courses*)

Students found course atmosphere as open and teachers' support as encouraging. Also interdisciplinary of teacher team was brought up. Assessment was viewed as diverse.

> […] always when you asked [from course teachers], you got instructions full of ideas but also the atmosphere was liberated. That it was possible to do things on your own. (P1, ≥*20 cr entrepreneurial courses*)

> There were teachers from different fields. One teacher had business as a special area, and another had expertise of product development, and one was in response of electricity issues. (P7, ≥*20 cr entrepreneurial courses*)

> […] self-assessment and peer assessment were applied, we had to give some grade to other group members. […] We got some grade from work, which was done during the whole course, not just from one exam. (P5, ≥*20 cr entrepreneurial courses*)

In the following, a participant describes co-learning among students as more important support for learning compared to support from course teachers:

> It was, or it is, a strongly multidisciplinary program and there is almost the same numbers of students from different disciplines. […] Although the course staff taught there, in practice I learned more from other students in group, since I had to co-operate with them to get the tasks done. […] (P6, ≥*20 cr entrepreneurial courses*)

Compared to aforementioned entrepreneurial courses, almost as many learning experiences were related to Bachelor's or Master's thesis (59) and courses with focus on substance and tools of own study domain (54). Often doing Bachelor's and Master's thesis, working process was bound to part-time or summer working in a company. Typically, participants told that they had thesis instruction both from the university and from the industry side.

> Above everything, networking because the thesis was done not only in co-operation with my company but also I had [funder's name] as a funder. (P7, ≥*20 cr entrepreneurial courses*)

> I got the thesis topic from my former summer job, where I am also going after graduation. There they gave the topic and I have been in kind of paid employment. […] With my superior, we have weekly gone through it, study direction, objective and they have given me contacts for finding information and for whom to ask. And the professor has given me more knowledge about academic requirements. (P1, ≥*20 cr entrepreneurial courses*)

The courses with focus on substance and tools included typically theoretical and practical courses of both Bachelor's and Master's curriculum, such as mathematics, physics, programming and laboratory work courses. These were either obligatory basic-level studies for all engineering students in Aalto (mainly in Bachelor's degree), or courses related to students' own study domain (in any phase of studies). Often, students described these courses as including lectures, exercises and exam and some courses also as including problem solving in groups, as following quotations indicate:

> Usually points are earned from exercises and the exam is designed primarily to test that you have solved the exercises on your own. […] There are weekly exercises and the lectures. But I have not been at lectures in any of those [programming] courses, since they all have included so good online materials. (P11, *0 cr entrepreneurial courses, at least 1 obligatory project course*)

> There we started to focus even more on the major subject of our own and to be immersed in it, of course it is still very extensive at that phase. […] especially problem solving. They [exercises] are done in groups and people had very different strengths. […] (P12, *0 cr entrepreneurial courses, at least 1 obligatory project course*)

Also courses that focused on business (42) were moderately represented. These courses concentrated on various business themes such as accounting, marketing and management. Minority of them also included entrepreneurship themes, typically integrated into engineering substance-related themes, for example medical device innovations or construction management. These courses were offered by Industrial Management study program, School of Business and students' own major programs. They were chosen both during Bachelor's and Master's studies, however the emphasis was slightly more in the Master's phase. Usually, students told about group working on a certain course theme or a business case, which required active working manners:

> I took some courses about industrial management, project business, basics of marketing and excel courses from business school. They were more compact, which meant group working and co-operation and little projects and deadlines and for example in accounting we had to do some summaries about business cases and then we handled it. I have heard that, it is quite a typical way to work in business school courses. […] These courses really forced students to co-operate. […] (P13, *0 cr entrepreneurial courses, at least 1 obligatory project course*)

> We had lectures maybe every week on the average, but there was a break of couple of weeks at some phase. […] There were three lectures present. We went through some materials. The idea was that they asked us some questions and we discussed about them during the lecture. […] At the end of the course we had a project, where everyone in the group should introduce one real problem that they have faced in working life. Then we had to think about the problem and options how it could have been solved in a better way. (P14, *0 cr entrepreneurial courses, at least 1 obligatory project course*)

Voluntary project courses (19), courses that aimed to develop generic competencies (12) and obligatory project courses (11) were mentioned less as sources of learning entrepreneurial competencies. Voluntary project courses included multidisciplinary project courses from several schools of Aalto, usually taken in Master's phase. These courses had focus on a certain topic or study area, such as life sciences, mechatronics or textile design in which participants' task was to design a product and in some cases, also make a prototype from the plan such offering possibilities to apply earlier learned theories into practice and to co-operate with real companies.

> There was a problem assigned by companies, and it should be solved by making a prototype. When building a prototype, many problems were faced and many things to be solved. And it taught huge amount of, extensively, those theories I had learned earlier, I had opportunities to apply in practice. (P4, *≥20 cr entrepreneurial courses*)

As related to entrepreneurial courses, also related to voluntary project courses participants described strong emphasis on students' team working. As the following quotation indicates, by getting to know different ways of working, it was possible to get new ways to think product development.

> […] there I worked with people of different background. And more about how they work, since it is quite different than here [in my own field]. Usually, here we start with some problem and by developing some solution to it, while there it was going out for a walk, seeing something interesting, taking pictures, doing a mood board and by thinking what could be done based on it. It was the wrong way round. (P3, *≥20 cr entrepreneurial courses*)

Courses that shared the aim to develop generic competencies were typically obligatory courses in the beginning of Bachelor's and Master's degree. In the following, a participant gives an example about an introductory course, where many kinds of generic competencies were practiced:

> We started from how to use Excel and then we went through IT skills. Then also in that course we discussed ourselves as learners and practiced time management. […] It was a lecture based course, in which once a week there was a deadline for course exercises. […] (P18, *0 cr entrepreneurial courses, 0 cr project courses*)

Finally, obligatory project courses were taken in the beginning of Bachelor's studies in Aalto, often already at first year. As well as in entrepreneurial courses, and voluntary project courses, also in these courses, students usually had to design a some kind of product together in a group. Participants described a strong focus on group working and multidisciplinary project working as well as assessment, which had emphasis on more on project working process than on the end result.

> […] it was completely group work course. […] we worked together and I had a team to work with. […] we had a good group and we proceeded the whole time. (P9, *0 cr entrepreneurial courses, at least 1 obligatory project course*)

> It was interesting to perceive that we had very different fields of expertise in that group. Compared to some physics project, where everyone comes from the same study program and has knowledge in the same subjects. In this course, I can do something and others can do different things and you can trust that they can do those things. […] First time, here was not a single project leader responsible of it. But everybody has access to the data and can have open discussions and knowledge about what is going on in the project at the moment and how it should be done. […] It [assessment] was related to the process and progress on it. It was not necessarily about what the end product looked like but more about progress in the project. (P8, *0 cr entrepreneurial courses, at least 1 obligatory project course*)

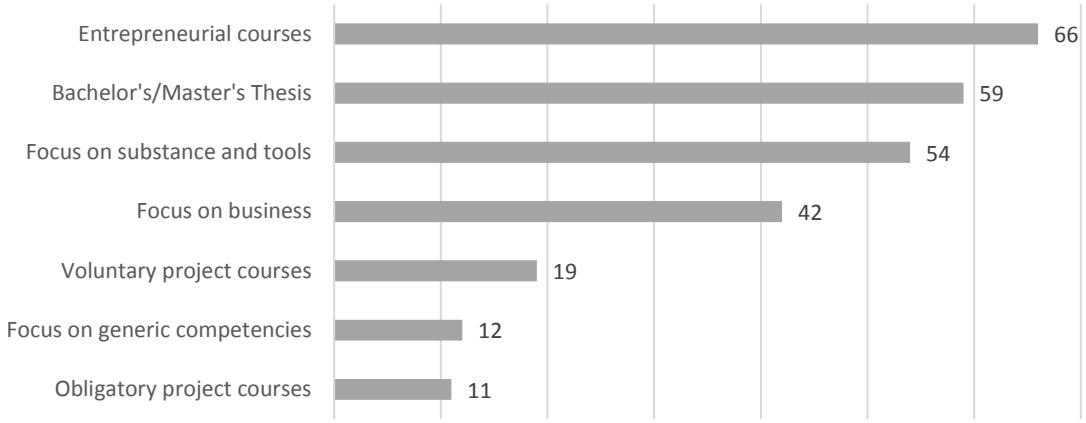

Figure 7. Formal learning environments (relations between learning experiences and course environments, *n* = 263)

Turning to informal learning environments, more than half of learning experiences located in them were related to working during studies and traineeships (see Figure 8). Working during studies came out as working in either own field or in other positions. Typically, students described part-time jobs but also summer jobs were mentioned by several participants. Traineeships were mainly done during summertime. A few students mentioned that traineeship was obligatory for them and it involved a course in which traineeship experiences were reflected by writing essays, as the following quotation clarifies:

> You do not have to work in your own field but it is recommended. Any kind of work is valid but you have to apply summer job positions by your own and then there is the course related to it. […] It is obligatory. […] There were texts that we wrote and then we made peer reviews to them and then also a course assistant gave us feedback. (P18, *0 cr entrepreneurial courses, 0 cr project courses*)

Activities of student associations or voluntary work were moderately represented. These activities included mostly acting in a responsive role in student associations but also other more flexible ways of acting in them as well as other kind of voluntary work, for example in non-governmental organizations. Participants experienced acting in student associations as educational, as they illustrate in the following quotations:

> Next, here I have a year in my study guild's board. […] It was a very instructive experience, especially from the viewpoint of administrative issues, since my guild is very punctilious about different kinds of things. […] (P12, *0 cr entrepreneurial courses, at least 1 obligatory project course*)

> There I did voluntary work. […] With quite little effort, you can get good experience of different tasks and you do not necessarily have to be an expert already. In certain tasks, you have to understand for example processes or how to process orders, so you will manage quite well. (P13, *0 cr entrepreneurial courses, at least 1 obligatory project course*)

Students described less often learning related to exchange studies, personal experiences and hobbies, participating events and military or civilian service. Exchange studies were done both during Bachelor's studies and in the beginning of Master's studies. Personal experiences and hobbies included single experiences perceived personally important, as discussions with other students or decision about changing study direction or leisure activities, for example traveling or acting in a sports club.

> From the exchange studies, there I learned enormously, especially because of jumping to another study area. It was, it is a good school of this field and I did not have any experience of that yet, so I had a chance to jump […] (P4, ≥*20 cr entrepreneurial courses*)

> I have been a coach of a [sports name] team already before starting studies here. But especially after starting studies I have taken it more seriously. […] It has been very instructive to me. I think I will utilize these experiences in future, if I am in response of some group. […] (P14, *0 cr entrepreneurial courses, at least 1 obligatory project course*)

Participating events was portrayed as participating hackathons, career consulting events, competitions and other kinds of activities typically organized in Aalto University ecosystem. Typically, students participated these events voluntarily at leisure time. Finally, a few relations were found between learning experiences and military or civilian service done during studies.

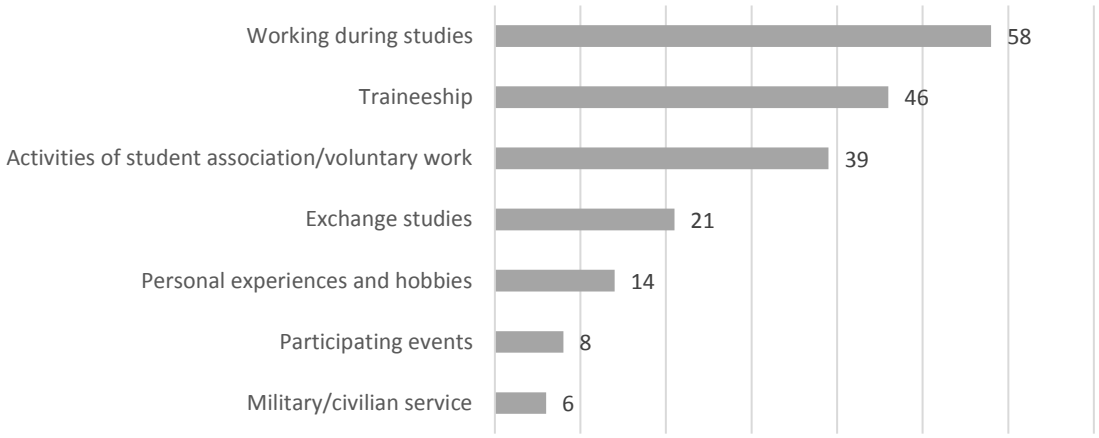

Figure 8. Informal learning environments (relations between learning experiences and informal environments, *n* = 192)

6.4 Relations between entrepreneurial competencies and learning environments

The third research question was addressed as *based on students' experiences, what kinds of relations are possible to recognize between learned competencies and learning environments.* Here, this question is answered mainly focusing on all students at a time and their learning related to formal (see Table 9) and informal environments (see Table 10). The reported learning experiences varied between student profiles. In general, students who had completed 20 or more credits of entrepreneurial courses, emphasized formal environments over informal environments as sources of learning entrepreneurial competencies, while students who had not completed entrepreneurial courses brought up more uniformly both formal and informal environments. For more detailed information, please see Appendix 6.

Starting with generic entrepreneurial competencies, learning social, communication and collaboration was recognized most and it was related to all formal and informal environments students brought up during the interviews. Regarding formal learning environments, students with 20 or more credits of entrepreneurial courses reported the most of relations between learning social, communication and collaboration competencies and formal environments. Emphasis of learning was on entrepreneurial courses. In addition, courses with focus on substance and tools, Bachelor's or Master's thesis, voluntary project courses and courses with focus on business were evenly represented. Turning to informal environments, especially students who had not completed entrepreneurial courses emphasized learning in traineeships, working during studies and activities of student association or voluntary work.

Information processing and problem solving competencies were reported as the second most common of generic entrepreneurial competencies related to formal learning environments. Learning them was experienced mostly related to Bachelor's and Master's thesis. In addition, courses with focus on substance and tools were seen strongly as sources of learning these competencies. Informal environments were not as visible as formal environments. Although there were

some relations between learning information processing and problem solving and in working during studies and traineeships.

Learning and reflection competencies were located rather much in formal environments. Learning experiences were scattered throughout many different environments, of which most often represented were courses that focus on substance and tools, Bachelor's and Master's thesis and voluntary project courses. Almost as many experiences were also found related to informal environments. Working during studies was especially given a high importance.

Compared to other generic entrepreneurial competencies above, learning international and ethical competencies were given low importance. Learning international competencies in formal environments was mainly related to entrepreneurial courses. However, learning international competencies got more weight in relation with informal environments, more precisely in exchange studies and activities of students association or voluntary work. Again, these informal environments were brought up especially by students who had not completed entrepreneurial courses. Learning ethical competencies was marginal related to formal environments and it did not show at all related to informal environments.

Continuing with entrepreneurship-specific competencies, learning business competencies was common both in formal and in informal environments. Learning experiences were represented almost as much in these contexts. Of the formal environments, courses with focus on business (brought up especially by students who had not completed entrepreneurial courses) were most presented but also entrepreneurial courses and courses with focus on substance and tools were also brought up moderately as sources of learning. Of informal environments, most importance was given to traineeships, working during studies and activities of student association or voluntary work.

Commitment and perseverance were the second most often brought up of entrepreneurship-specific competencies. Equally, as business competencies, learning them was reported rather constantly related both to formal and informal environments. Of formal environments Bachelor's of Master's thesis was particularly emphasized. Of informal environments, especially traineeships and

working during studies were named as sources of learning. Development of commitment and perseverance competencies both in formal and in informal environments was identified mostly by the students, who did not have any entrepreneurial studies, but had accomplished at least one obligatory project course.

Learning opportunity recognition competencies was clearly indicated more in relation to formal than to informal environments. Entrepreneurial courses were particularly viewed as sources of learning. A few relations were also found between learning opportunity recognition and obligatory project courses. Of informal environments, learning of these competencies was few times connected both to working during studies and to exchange studies.

Finally, industry-specific competencies and networking competencies were both represented marginally. Learning them was recognized by students with 20 or more credits of entrepreneurial courses, and students who did not have any entrepreneurial studies, but had accomplished at least one obligatory project course. Students who had not accomplished entrepreneurial courses or obligatory project courses did not recognize learning industry-specific nor networking competencies.

Industry-specific competencies were equally recognized as learned from formal and informal environments. Of formal environments, the emphasis was on courses that focus on business. Related to informal environments an equally clear focus point was not found, but both working during studies and traineeships were couple of times connected with learning industry-specific competencies. Learning networking competencies was more related to informal environments than formal environments. It was only once connected both to entrepreneurial courses and Bachelor’s or Master’s thesis, while in informal environments, learning was connected clearly to activities of student association or voluntary work.

Table 9.

Relations between experiences of learning entrepreneurial competencies and formal environments, all students (N = 18)

	Entrepreneurial competencies / Formal learning environments	Entrepreneurial courses	Bachelor's / Master's Thesis	Focus on substance and tools	Focus on business	Voluntary project courses	Focus on generic competencies	Obligatory project courses	Σ[a]
Generic	Social, communication and collaboration	29	10	16	9	10	6	2	82
	Information processing and problem solving	2	19	14	0	2	0	0	37
	Learning and reflection	2	5	6	2	4	2	0	21
	International	4	0	0	0	0	1	0	5
	Ethical	1	0	0	1	0	0	0	2
Entrepreneurship-specific	Business	12	4	10	23	3	1	5	58
	Commitment and perseverance	2	17	5	1	0	2	1	28
	Opportunity recognition	13	2	2	2	0	0	3	22
	Industry-specific	0	1	1	4	0	0	0	6
	Networking	1	1	0	0	0	0	0	2
	Σ	66	59	54	42	19	12	11	263

[a]Sums are based on relations between competencies and environments. Therefore they differ from sums of learning experiences presented in Chapters 6.1 and 6.2.

Table 10.

Relations between experiences of learning entrepreneurial competencies and informal environments, all students (N = 18)

	Entrepreneurial competencies / Informal learning environments	Working during studies	Traineeship	Activities of student association / voluntary work	Exchange studies	Personal experiences and hobbies	Participating events	Military / civilian service	Σ[a]
Generic	Social, communication and collaboration	18	9	18	6	2	3	2	58
	Learning and reflection	9	3	0	1	2	0	0	15
	Information processing and problem solving	4	2	0	1	0	1	1	9
	International	0	0	3	6	0	0	0	9
	Ethical	0	0	0	0	0	0	0	0
Entrepreneurship-specific	Business	13	17	10	3	6	3	2	54
	Commitment and perseverance	9	11	2	1	3	0	1	27
	Opportunity recognition	3	1	1	3	1	0	0	9
	Industry-specific	2	2	1	0	0	1	0	6
	Networking	0	1	4	0	0	0	0	5
	Σ	58	46	39	21	14	8	6	192

[a]Sums are based on relations between competencies and environments. Therefore they differ from sums of learning experiences presented in Chapters 6.1 and 6.2.

7 Discussion

This research aimed to shed light into the current situation of entrepreneurial education. It explored, what kinds of entrepreneurial competencies students report to have learnt during studies. It identified, in what kinds of learning environments students report to have learnt entrepreneurial competencies. It also uncovered relations between learning experiences and environments. The present study combined perspectives of two research traditions previously considered separately: educational outcomes and learning processes. It brought added value to the research field of entrepreneurial education by applying a focus on students' experiences, which has been a minor view so far. In addition, it broadened a perspective from single courses and course modules to a wider context of university ecosystem, holistically taking into account learning both in formal and in informal environments.

A wide spectrum of entrepreneurial competencies was learned

According to the results the entrepreneurial courses organized by Aalto University supported learning both generic entrepreneurial competencies and entrepreneurship-specific competencies. The most importance was given to learning of social, communication and collaboration competencies and business competencies. These results are consistent with previous researchers' conclusions that entrepreneurial competencies are possible to educate (e.g. Dickson et al., 2008; Dutta & Merenda, 2011; Egerová et al., 2017; Hindle, 2007; Lans et al., 2014; Oosterbeek et al., 2010; Schelfhout et al., 2016). Equally, they give support to previous empirical evidence about effects of education on entrepreneurial competencies (Barba-Sánchez & Atienza-Sahuquillo, 2018; Din et al., 2016; Karimi et al., 2016; Maresch et al., 2016; Mueller, 2011; Packham et al., 2010; Zhang et al., 2014). This study complements the perspectives of aforementioned researches by bringing out the more accurate view about what kinds of competencies are learned.

The results indicated that the overall picture of entrepreneurship was formed only to students who had accomplished several entrepreneurial courses. Entrepreneurial studies were supportive in learning competencies needed in

early-phase entrepreneurship (such as opportunity recognition) concerning only those students who had been active to seek their path to voluntary entrepreneurial studies. Students from all backgrounds brought up learning business competencies and commitment and perseverance competencies. This means that they recognized learning competencies for business running in already established ventures (see Baron, 2007) as well as self-management, responsibility, ownership and tolerance of setbacks (see Gibb, 2005; Ismail et al., 2015; Man et al., 2002; Schelfhout et al., 2016). However, students who did not voluntarily choose entrepreneurial courses got an incomplete picture of entrepreneurship – they did not learn about early-phase entrepreneurship, which is recognizing opportunities and acting on them (see Fisher et al., 2008; Gibb, 2005; Mitchelmore & Rowley, 2010). Learning these competencies is relevant to everyone, because opportunity-recognition is a base for innovative action in any kind of organization (see Bjornali & Støren, 2012). Considering all participants, it should be noted that not any course or course program was reported as a single source of holistic set of entrepreneurial competencies. These results evoke a question about how to broaden accessibility of courses that support learning more comprehensively about early-phase entrepreneurial action. Could entrepreneurial courses be broadened to cover curricula of all students? On the other hand, could elements of entrepreneurial courses be integrated into those courses that all students already have in their study programs?

The findings imply that current entrepreneurial education does not support learning of ethical competencies. Only a small number of participants referred to ethical issues as a part of their learning experiences resulting from both formal and informal environments. Several previous competency frameworks did not explicitly mention business ethics (e.g. Láckeus, 2014; Lans et al., 2011; Man et al., 2002; Mitchelmore & Rowley, 2010). Following, if competency-based models are used as a base of setting goals in course planning, it is possible that ethical themes have been left in shadow. However, ethical competencies are essential as a base for ethical entrepreneurial action (Kakkonen, 2012a; Strijbos et al., 2015). They are especially important what comes to potential clients, since an entrepreneur is a representative of a brand (Inyang & Enuoh, 2009). Still, developing ethical working manners is not easy; it requires a long socialization

process in authentic professional environment (see Kakkonen, 2012b). Therefore, based on the results, it could be asked, whether ethical competencies could be recorded more closely into entrepreneurial education curricula, starting already from Bachelor's study phase.

Elements of informal learning had a strong role in learning entrepreneurial competencies

The results imply that combining formal learning environments with elements of informal learning environments resulted as a wide spectrum of learned entrepreneurial competencies. Students emphasized learning environments that were based on co-operative, group-based and problem- or project-based settings. They especially brought up skill-based tasks and learning that happened through simulating real-life settings. Thus, in line with the previous studies, methods that include the combination of elements of formal and informal learning ("for" and "through" entrepreneurship) were seen promising ways to apply in entrepreneurial education (see e.g. Florin et al., 2007; Gibb, 1993; Kyrö & Carrier, 2005; Láckeus, 2014; Markman, 2007). Learning of entrepreneurial competencies can be seen as a holistic process that is located to wider context of university ecosystem and students' own activities. In line with the message of previous studies, the question is not only about building an entrepreneurial environment into a context of a single course, but about holistic and general solutions related to university pedagogics and learning environment overall (see Kyrö, 2005; Ruohotie & Koiranen, 2000).

According to the findings, in the context of higher education of engineering fields both Bachelor's and Master's thesis have an important role as a unifier of formal and informal learning of entrepreneurial competencies. Even though, theses were included in formal learning environments, they also include remarkable amount of elements of informal learning (see Tynjälä, 2008). In the engineering fields, theses have traditionally been an important source of authentic working life project experiences. Thus, it is already an existing solution to be utilized as a part of entrepreneurial education. Based on the findings, can be discussed, whether theses could be developed towards offering even more possibilities for students to gain integrate competencies learned from academic environment into learning

of industry-specific entrepreneurial competencies from authentic business environment (see Lans et al., 2014).

Finally, the results imply that other than entrepreneurial courses do not directly support development of entrepreneurial competencies. The students had difficulties in recognizing learning of entrepreneurial competencies from project courses that were not directly related to entrepreneurship. Although, the pedagogical elements of project courses appeared similarly as those of the entrepreneurial courses, the project courses were not supportive for learning entrepreneurial competencies as such. On the other hand, based on the common characteristics, project courses could be potential targets for integrating entrepreneurial courses into them. Voluntary project courses offered in Master's phase were seen supportive in learning of generic entrepreneurial competencies, while obligatory project courses of Bachelor's phase obligatory were reported to support learning entrepreneurship-specific competencies. The latter have already been targeted resources for integrating elements of entrepreneurial courses into them, which may explain the learning results. Bachelor's phase courses reach large groups of students, which makes them useful in introducing the faculty and supporting development of their intellectual capacity (see Dym et al., 2005; Froyd et al., 2012). For creating possibilities to even more students to learn comprehensively about entrepreneurship, these findings encourage university to further actions for integrating elements of entrepreneurial courses into project courses.

7.1 Limitations

Since making qualitative study is a flexible process, in which a researcher makes continuously decisions and constructs methods according to their research task, demand for transparency in reporting is obvious (see Tuval-Mashiach, 2017). Thus, a very important premise for writing this report has been to offer a reader detailed, transparent information about all solutions made during the process. By acting this way, the aim has been to increase a reader's possibilities to make their

own evaluation of limitations. However, making some explicit notes about limitations is justified to set the ground for reader's evaluations.

According to Agar et al. (2004) qualitative study is typically evaluated in its own language, where terms differ from reliability and validity used in quantitative tradition. Various alternative concepts have been suggested for qualitative research evaluation, they continue, to avoid possible stamp of positivism. For this research, Lincoln and Guba's (1985) well-known four qualitative evaluation criteria were chosen as a base for discussing limitations. These dimensions are credibility, confirmability, dependability and transferability. In the following, they are examined one by one, considering the whole research process.

Credibility

First, credibility is evaluated for defining to what extent a researcher's interpretations correspond the original constructions of the phenomenon under research (Lincoln & Guba, 1985). For building credibility, in this research process prolonged engagement, persistent observation and triangulation recommended by Lincoln and Guba have been utilized as starting points. First, prolonged engagement means using sufficient amount of time for getting to know the context and its culture, which is needed to ensure that a researcher succeeds in building a background for a research (Lincoln & Guba, 1985). Here, a prolonged engagement began by simultaneously getting to know the context as well as observing the context and its phenomena in the light of previous research. Already at the first days of the process, the researcher started to discuss with several people in the research context for getting a thorough picture of entrepreneurial ecosystem of Aalto. These discussions with especially Aalto University's teaching staff were continued several times during the research process.

Second, with persistent observation Lincoln and Guba (1985) denote continuing data collection long enough. In this study, intensive interview phase lasted several weeks and all potential participants were surveyed by sending several requests to attend. In selection of participants, special attention was targeted to their study backgrounds. Background analysis was carefully carried out for sending invitations to a diverse group of participants. As an outcome, 18 students

from three different profiles attended to interviews, resulting a comprehensive data.

Third mean to enhance credibility by Lincoln and Guba (1985) is triangulation, which they refer to utilizing several sources, methods and external people. Here, the literature review was intentionally created on a wide base of sources. Also, several qualitative methods and data quantification were applied together, creating a novel approach to entrepreneurial education research. Competency categorization and analysis frame based on it were built during iterative and long lasting process, which also included several discussions with supervisors. Courses chosen to include in the criteria of this study based on common characteristics were defined in co-operation with both supervisors and teaching staff of Aalto, who had deep expertise of the context. Also, couple of times in the beginning and in the middle of the process the researcher received valuable feedback in international context from stakeholders in the Entrepreneurship Ecosystems in Engineering and Technology Erasmus+ project. Thus, the research questions and understanding of the centric phenomena were born in the active co-operation with several directions.

Confirmability

Confirmability should be evaluated as to what extent the findings are neutral from researcher's own bias and interest, so that respondents interpretations are not manipulated (Lincoln & Guba, 1985). In the interview situations, taking neutral and objective role as a researcher was easy because the researcher had not studied in Aalto herself and did not have any other personal bounds either. Since participants were aware of the researcher's role as an outsider, they often clarified contextual information explicitly, which probably prevented researcher's bias in analysis.

Each participant was introduced systematically the same questions in the interview following the interview frame, which was several times walked through with supervisors. In addition, the interview frame was also several times piloted to ensure that the questions are understood similarly by all participants. Based on these pilot interviews, questions that first were answered inconsistently were modified to achieve better comprehensibility. To be able to refine questions when

needed and to ask open supplementary questions in the actual interviews, the researcher had oriented widely to the study field beforehand. After each interview, she took notes and reflected the situation and her own reactions to participant's comments for being aware of possible bias.

In the analysis phase, neutrality was strengthened by interpreting meaning units several times and comparing them to each other. In addition lifeline pictures produced by participants as well as Aalto study guides were utilized for ensuring the correct direction of interpretations. In this report, the analysis frame is presented to readers for making possible evaluations about its proficiency. In reporting the results, lots of quotations have been displayed as justification for interpretations made by researcher. In the analysis phase, the researcher made precise analysis notes, which made possible to accurately reconstruct the process to the report.

Dependability

Evaluation of dependability covers research situation, including both external factors and internal qualities of phenomenon itself, as causes of variation (Lincoln & Guba, 1985). It should be noticed that the data in this study represent only a viewpoint of a single class. There may exist contextual differences between student groups of different disciplines in the same course (Maresch et al., 2016). There is always a possibility that the results could have been different if the target group was students, who have started their studies at some other academic year. The participants of this study, who had started in Aalto at autumn 2013, had to face a wide degree reform made around the same time as their studies began. Several participants brought up this educational reform as challenging in organization of courses. In addition, should be noted that all participants were engineering students due to the definition of Erasmus+ project's target group. Thus, it is possible that for example architecture and business students could have brought up different viewpoints into development of entrepreneurial competencies in Aalto.

In interview situations, general activity of participants may have produced more than average amount of learning experiences. Probably they are more active than an average student to participate many kinds of activities. This may result as

more than average activity in participating in entrepreneurial and business courses. The background analysis revealed that 27 percentages of students are not reached by either entrepreneurial or obligatory project courses. This student group was least represented in the interviews and many of these participants had been active for example in student associations. Therefore, careful discussion should be made, if making generalizations considering students who did not have experience of entrepreneurial courses, obligatory project courses and voluntary leisure time activities.

There might have also been personal differences between single participants in the interviews. Whether a course is voluntary or obligatory has effects on students' learning (see Karimi et al., 2016). People already interested in entrepreneurship might choose entrepreneurial courses - they observe courses and learning results more positively compared to other students (see Kakkonen, 2012b; Piperopoulos & Dimov, 2015). Can possibly be assumed that students who have taken entrepreneurial courses have more vocabulary for recognizing learning for example networking or industry-specific competencies. Students who did not have taken any entrepreneurial courses and obligatory project courses did not report these competencies. In addition, there is a possibility that students have viewed certain competencies through some other competency concept, which is easier to name. For example, students might have seen international competencies as social competencies, if they have participated in plenty of social activities abroad.

Although, using narrative method was a well-founded mean to get access to participants learning reflection considering the period of several years, it set its own limitations to the research of entrepreneurial competencies. Although, in this study, competencies were intentionally analyzed as entities and not divided into components of knowledge, skills and attitudes, the researcher noticed that learning attitude components was not as strongly represented as learning knowledge and skills were. Narrative method did not make it possible to ask directly about attitudes (see Jovchelovitch & Bauer, 2000). The other possible reason may be that attitudes were really learned less, as in previous studies they are viewed as more difficult to promote in the context of formal education than

knowledge or skills (see Florin et al., 2007; Láckeus, 2014; Markman, 2007). Related to using lifeline approach, should be remembered that due to typical features of memory functioning, recalling events that have happened a long time ago is more difficult than producing descriptions of events that happened for example yesterday (Assink & Schroots, 2010). This means that there is possible bias so that recent incidents have got the most attention.

Limiting the research to competencies as learnable entities was justified in terms of the research task. However, it is important to be aware of other factors and low-level personal attributes that might mediate learning entrepreneurial competencies, but remain out of reach in this setting. These background factors may affect reporting learning experiences. For example, working experience as an entrepreneur, role models from family and working during studies may affect learning of competencies (Fayolle & Gailly, 2015; Taatila & Down, 2012). Positive self-esteem, entrepreneurial spirit, and later phase of studies as a possible source of already developed knowledge-base can equally distort self-reported competencies (Fisher et al., 2008).

Due to the critical incident research agenda, starting point was participants' own interpretations of learning experience (see Tripp, 2012). Therefore, the researcher did not delete possibly overlapping meaning units in the analysis phase, even though some participants might have brought up the experiences of same content several times. This kind of repetition could have signified the importance of that experience to the participant, which is why it should be viewed as an essential feature of the data produced by the critical incidents method. Still, it sets a requirement for criticality especially when making conclusions based on quantified learning experiences. Noticing these limitations, both qualitative and quantitative approaches were used in presenting the results.

Transferability

Evaluation of transferability is about how transferrable the results are to other contexts, which is dependable on similarities of contexts (Lincoln & Guba, 1985). Ultimately, it remains as a reader's decision, whether these results are applicable to a certain context or not. For making possible these kinds of justifications,

context was described in detail in Chapter 5. Therefore, in this part, emphasis is on couple of general remarks on transferability.

Contextual factors of entrepreneurship education arrangements challenge applicability of research in developing courses or programs. Cultural, political and national circumstances define aims and implementation of entrepreneurial education in institutional context (Fayolle & Kickul, 2007; see also Pittaway & Cope, 2007a). In this case, Aalto University has its unique governance, culture and infrastructure, which has developed during the decades as well as relations to companies and student entrepreneurship networks. Thus, the application of results should be considered critically case-by-case.

Although applying results as such is challenging, the analysis method and framework can be more applicable in other contexts. Based on theoretical review combined with abductive reasoning on the data, this research led to the creation of new categorization of entrepreneurial competencies. It complemented previous competency categorizations by two completely new subcategories of business competencies: organizational understanding and bureaucratic understanding. The analysis framework seemed competent in analyzing learning entrepreneurial competencies, which sets ground for future applications. However, when applying the framework of this research to a new context, it is worth to remember possible cultural differences that effect on perceiving entrepreneurial competencies. For example, Kakkonen (2011) concluded that Finnish students perceive their entrepreneurial competencies lower than international students do.

7.2 Suggestions for future research

As the discussion of limitations showed, this study had access only a limited viewpoint of entrepreneurial learning. The study was based on self-reported competencies and the data was collected only at one time point. Thus, the most centric suggestions for future research concern broadening the analysis to cover learning reported from more diverse target group and sources, making follow-up

study of learning process, and analyzing outcomes of possible educational interventions. In addition, the analysis method and frame could be applied to new environments for producing information to enable comparison of results produced in this study.

First, an expanded target group and using more diverse sources of data are suggested. This research had focus only on one class of engineering students. It is possible that the educational reforms made have already changed the learning conditions after these participants have acquired their experiences. Therefore, future research could be broadened to cover more classes of engineering students. Also, since entrepreneurial education is seen useful for students of all disciplines (Boyles & College, 2012; Kucel et al., 2016) and courses are made accessible to growing number of different fields (Frank, 2007), also other than engineering students could be considered as a target group to enhance applicability of results. Since there was a great number of students in Aalto University, who had not accomplished either entrepreneurial courses or project courses, reaching these students better to understand their entrepreneurial learning paths, is a challenge for future research. Especially, those students who are not active in free time informal learning should be reached.

Possible self-reporting bias discussed in limitations of this research, could be minimized by using more diverse information sources. In other words, more methodic triangulation suggested by Lincoln and Guba (1985) could be considered. Self-reported information about learning could be complemented with other assessment methods and mixed-methods settings (see Láckeus, 2014). For example, teachers' assessments could be a possible source to complement students' self-reflection. In addition, this study did not have a profound access to attitudes or intentions with narrative method. Since attitudes are viewed to have a mediating role between entrepreneurial intentions that precede entrepreneurial behavior (Krueger, 2007), they are essential to be covered in addition of knowledge and skills when making research about entrepreneurial learning. Also possible effects of low level attributes as motivation and personality, as well as factors related to home and free-time environments that may effect on learning and integration of competencies (see e.g. Mateo et

al., 2012), could be taken into account in a more detailed level. Accessing these low-level elements and so-called deep-beliefs could happen for example by utilizing broader surveys (see Krueger, 2007).

Secondly, a follow-up study could deepen the view into entrepreneurial learning process. A follow-up setting with diverse methods would enable acquiring information about impact of some specific educational environment for competency development (Fayolle et al., 2006). Together with collecting information about low-level elements, a better understanding of long-time cumulative effects of studies and background elements could be achieved. With more extensive data, this kind of a follow-up setting would make it possible to combine students' anonymous id, learned competencies and learning environmental factors, thus producing information about students' unique study paths. In practice, this information could support pedagogical development by enhancing possibilities to notice the needs of different student profiles.

The third major suggestion for future research is intervention studies. Based on the results, some suggestions about enhancements into engineering education curricula and teachers' professional networking possibilities were made. If these enhancements were carried out, the possible effects should be explored to have a base for further action. The followed effects could include for example students' learning results and teachers visions about their own potential as entrepreneurial educators.

Finally, the analysis method and frame introduced in this study could be applied into other environments to produce results that meet local conditions, of which implementation of entrepreneurial education is depended (see Fayolle & Kickul, 2007). Overall, the analysis method that combines learning results and learning process related factors is a novel approach into entrepreneurial education research. It may enable creating even a more detailed model of entrepreneurial learning in the future.

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Appendices

APPENDIX 1

Research invitation

Hello,

Would you like to discuss about development of your working life skills during studies?

I am doing a Master's thesis of educational sciences in University of Helsinki. The focus is on development of working life skills in Aalto University. This study is a part of international EU project where Aalto is one of the participant universities. For research purposes, I interview engineering students of Aalto University.
As a participant, you would help to collect important information for a basis of pedagogical development in Aalto University. Additionally, as a compensation, you will get an umbrella with Aalto logo on it!

The interviews will be at Otaniemi during April and May 2018. The length of interview situation is about one hour. Participation is voluntary and as a participant you can also discontinue the interview. The interviews will be recorded and transcripted.

I got your contact information from study register of Aalto for purposes of this research. You can not be directly identified from the final report based on your answers. Collected data is used only for purposes of this research project, which includes both the Master's thesis and possible publications in future. Study record data will be destroyed after the research has completed. The researcher ensures safe storage of the interview data, where all identification information is already deleted.

Registration to the interview is easiest through this form: [the link to the form]. I will contact you based on the details you give. The responses are visible only to me as a researcher. Your answers will be deleted from the database after contacting you.
You can also reply to this message, so that we could find a suitable time for an interview!

Best regards,
Hanna Aarnio

[researcher's phone number]
[researcher's email]

APPENDIX 2

Interview frame

PART I

1) What kind of skills you have used at work/studies during the last week?

2) In more general, what kind of skills are needed in working life in your opinion? (Focusing, if needed: What kind of skills are needed for successful acting in working life?)

PART II

3) Now, I would ask you to think about, what kind of skills important for working life you have learned during studies. You can observe for example courses, project works and internship. Draw an informal timeline that describes how your working life skills have developed during studies. You can draw a line freely to describe the phases for example with ups and downs, turning points or with a flat line. On the line you can also name the things that have supported development of the skills according to your experiences.

PART III

4) Let us now observe the line together starting from the beginning. You have first mentioned… on the line…

- Why was this situation important and meaningful to you?
- What kind of skills useful in working life you learned?
- And what kind of facts useful in working life you learned?
- Let us have a further discussion about your learning experiences here.

  (Ask as exact questions about the learning environment as possible for forming a comprehensive view. For example: who were attending, what were the goals, what was done in the course, how was the course organized, what kind of guidance you got from the teacher, what kind of exercises the course included, did the course require doing of some kind of project (what kind of), did you cooperated with someone from real working life (what kind of cooperation you did have), what kind of final result was born in the course, how was your performance assessed)

- What was your experience here about the most important things for development of your working life skills?
- Could you give an example of experience that you felt important for development of your working life skills?

APPENDIX 3

Research consent

I volunteer as a participant with conditions as follows:

1. **The study topic**

   The research focuses on learning of working life skills of Aalto University engineering students'. The aim is to produce information to a basis of pedagogical development work of Aalto University. The research is a part of EU project where Aalto University is one of the participant universities.

2. **The researcher**

   Hanna Aarnio, . You can be in contact with the researcher, if you would like to have additional information about the research.

   The researcher has got emails and study records of potential participants from study register of Aalto University and targeted recruitment messages based on analysis of this information. The researcher is a keeper of register and takes responsibility of destructing register data after the research is completed.

3. **Data collection**

   The research is implemented by interviewing enigneering students of Aalto University during spring 2018. The research contains only one data collection point. Participation to interview lasts about one hour. To facilitate researcher's work the interview will be recorded and trancripted. Any identification data will not be delivered to transcription service used in the project. As a review from participation the participant gets an Aalto umbrella.

4. **Voluntary participation**

   Participation to the study is voluntary. At anytime, you can refuse to answer certain questions, discuss certain topics or even put an end to the interview without any negative consequences.

5. **Data processing**

   Data is collected and used only for purposes of this study project, which includes both the Master's Thesis and possible publications in future. All data is treated confidentially. Data without identification information is property of Aalto University. After the research is completed, the data is stored in a locked file cabinet appointed by the project leader. Material containing identification information will not be disclosed to third parties. In the final report anonymity of participants will be ensured so that participant can not be identified by the responses. However, direct interview quotations connected to backround information (for example gender and study backround) can be presented in the research report.

_____ _____

Date Participant's signature

_____ _____

Date Researcher's signature

APPENDIX 4

Background information form

Gender: ☐ Female ☐ Male ☐ Other ☐ I do not want to answer

Age: _____ years

School:
☐ School of Engineering
☐ School of Chemical Engineering
☐ School of Science
☐ School of Electrical Engineering

Study program: _____

Major / Study Direction (if chosen): _____

Former Study Program and Major (if changed): _____

Working while studying:

☐ regularly, weekly I do about _____hours work (approximation is enough)
☐ unregularly, specify here if necessary: _____
☐ previously I have worked while studying, but at this moment I do not work
☐ I do not work, and previously I have not worked while studying
☐ I do not want to answer

Before I started full-time studying in Aalto (choose every option that fits):

☐ I graduated from high school or from some other school
☐ I performed a military service / civilian service
☐ I worked full-time _____ years (approximation is enough)
☐ I already had a degree from university / applied university
☐ other alternative, please specify: _____
☐ I do not want to answer

During studies in Aalto, in my free time I have participated in activities of student association or other network or have done volunteer work?

☐ no

☐ yes, I have acted in these organizations / networks: _____

_____

☐ I do not want to answer

If I answered yes to the previous question, what was my role in the organizations / networks, or how I participated?

_____

_____

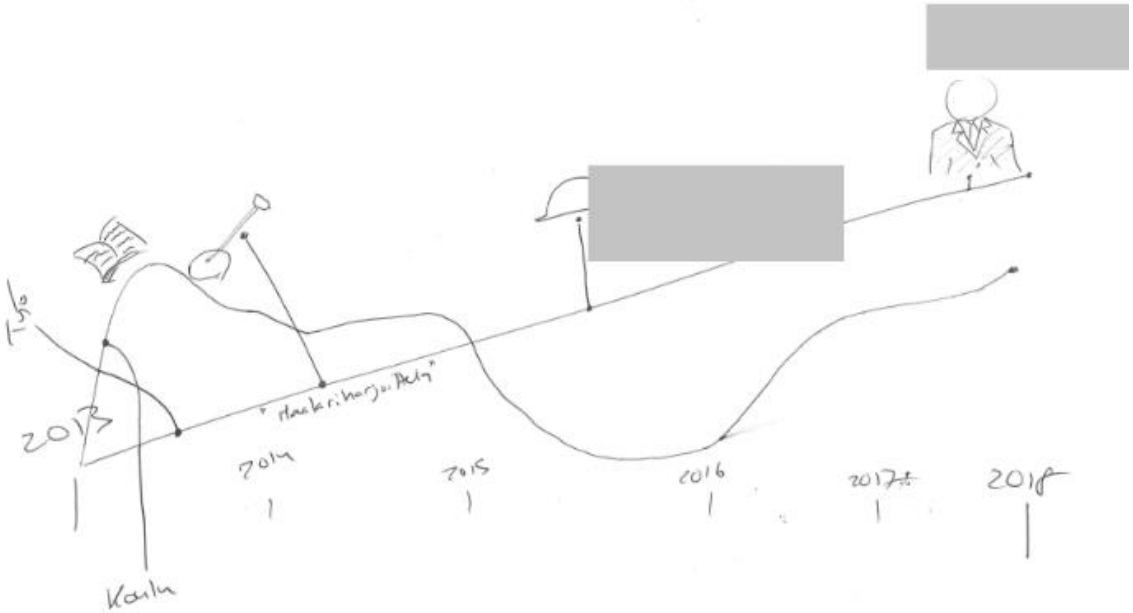
_____

_____

_____

APPENDIX 5

Example of lifeline



APPENDIX 6

More detailed relations between learning experiences and environments by student groups

STUDENTS WITH ≥20 cr ENTREPRENEURIAL COURSES (*n* = 7)

Relations between experiences of learning entrepreneurial competencies and formal environments (*n* = 128)

	Entrepreneurial competencies / Formal learning environments	Entrepreneurial courses	Bachelor's / Master's Thesis	Voluntary project courses	Focus on substance and tools	Obligatory project courses	Focus on business	Focus on generic competencies	Σ[a]
Generic	Social, communication and collaboration	29	5	8	3	1	0	3	49
	Information processing and problem solving	2	8	2	4	0	0	0	16
	Learning and reflection	2	0	4	2	0	0	0	8
	International	4	0	0	0	0	0	0	4
	Ethical	1	0	0	0	0	0	0	1
Entrepreneurship-specific	Business	12	2	3	2	2	2	0	23
	Opportunity recognition	13	2	0	1	1	1	0	18
	Commitment and perseverance	2	1	0	3	0	0	0	6
	Networking	1	1	0	0	0	0	0	2
	Industry-specific	0	1	0	0	0	0	0	1
	Σ	66	20	17	15	4	3	3	128

[a]Sums are based on relations between competencies and environments. Therefore they differ from sums of learned competencies presented in Chapters 6.1 and 6.2.

Relations between experiences of learning entrepreneurial competencies and informal environments (*n* = 45)

	Entrepreneurial competencies / Informal learning environments	Traineeship	Working during studies	Activities of student association / voluntary work	Exchange studies	Personal experiences and hobbies	Participating events	Military / civilian service	Σ[a]
Generic	Social, communication and collaboration	0	1	4	2	0	1	1	9
	Learning and reflection	3	3	0	1	1	0	0	8
	Information processing and problem solving	0	0	0	0	0	1	0	1
	International	0	0	0	1	0	0	0	1
	Ethical	0	0	0	0	0	0	0	0
Entrepreneurship-specific	Business	4	3	1	0	0	2	2	12
	Commitment and perseverance	2	1	0	0	2	0	0	5
	Opportunity recognition	1	0	0	2	1	0	0	4
	Networking	0	0	3	0	0	0	0	3
	Industry-specific	1	1	0	0	0	0	0	2
	Σ	11	9	8	6	4	4	3	45

[a]Sums are based on relations between competencies and environments. Therefore they differ from sums of learned competencies presented in Chapters 6.1 and 6.2.

STUDENTS WITH 0 CR ENTREPRENEURIAL COURSES, AT LEAST 1 OBLIGATORY PROJECT COURSE (*n* = 7)

Relations between experiences of learning entrepreneurial competencies and formal environments (*n* = 95)

	Entrepreneurial competencies / Formal learning environments	Bachelor's / Master's Thesis	Focus on substance and tools	Focus on business	Obligatory project courses	Voluntary project courses	Focus on generic competencies	Σ[a]
Generic	Social, communication and collaboration	5	8	5	1	2	1	22
	Information processing and problem solving	8	8	0	0	0	0	16
	Learning and reflection	4	3	0	0	0	0	7
	Ethical	0	0	1	0	0	0	1
	International	0	0	0	0	0	0	0
Entrepreneurship-specific	Business	2	5	14	3	0	0	24
	Commitment and perseverance	13	2	1	1	0	0	17
	Industry-specific	0	1	4	0	0	0	5
	Opportunity recognition	0	0	1	2	0	0	3
	Networking	0	0	0	0	0	0	0
	Σ	32	27	26	7	2	1	95

[a]Sums are based on relations between competencies and environments. Therefore they differ from sums of learned competencies presented in Chapters 6.1 and 6.2.

Relations between experiences of learning entrepreneurial competencies and informal environments (*n* = 101)

	Entrepreneurial competencies / Informal learning environments	Working during studies	Traineeship	Activities of student association / voluntary work	Personal experiences and hobbies	Exchange studies	Military / civilian service	Participating events	Σ[a]
Generic	Social, communication and collaboration	13	6	6	2	2	1	0	30
	Information processing and problem solving	3	2	0	0	0	1	0	6
	Learning and reflection	4	0	0	1	0	0	0	5
	International	0	0	2	0	3	0	0	5
	Ethical	0	0	0	0	0	0	0	0
Entrepreneurship-specific	Business	7	3	8	6	2	0	1	27
	Commitment and perseverance	6	8	1	1	1	1	0	18
	Opportunity recognition	3	0	1	0	0	0	0	4
	Industry-specific	1	1	1	0	0	0	1	4
	Networking	0	1	1	0	0	0	0	2
	Σ	37	21	20	10	8	3	2	101

[a]Sums are based on relations between competencies and environments. Therefore they differ from sums of learned competencies presented in Chapters 6.1 and 6.2.

STUDENTS WITH 0 CR ENTREPRENEURIAL COURSES, 0 CR OBLIGATORY PROJECT COURSES (*n* = 4)

Relations between experiences of learning entrepreneurial competencies and formal environments (*n* = 40)

	Entrepreneurial competencies / Formal learning environments	Focus on business	Focus on substance and tools	Focus on generic competencies	Bachelor's / Master's Thesis	Σ[a]
Generic	Social, communication and collaboration	4	5	2	0	11
	Learning and reflection	2	1	2	1	6
	Information processing and problem solving	0	2	0	3	5
	International	0	0	1	0	1
	Ethical	0	0	0	0	0
Entrepreneurship-specific	Business	7	3	1	0	11
	Commitment and perseverance	0	0	2	3	5
	Opportunity recognition	0	1	0	0	1
	Industry-specific	0	0	0	0	0
	Networking	0	0	0	0	0
	Σ	13	12	8	7	40

[a]Sums are based on relations between competencies and environments. Therefore they differ from sums of learned competencies presented in Chapters 6.1 ja 6.2.

Relations between experiences of learning entrepreneurial competencies and informal environments (*n* = 46)

	Entrepreneurial competencies / Informal learning environments	Traineeship	Working during studies	Activities of student association / voluntary work	Exchange studies	Participating events	Σ[a]
Generic	Social, communication and collaboration	3	4	8	2	2	19
	Information processing and problem solving	0	1	0	1	0	2
	Learning and reflection	0	2	0	0	0	2
	Ethical	0	0	0	0	0	0
	International	0	0	1	2	0	3
Entrepreneurship-specific	Business	10	3	1	1	0	15
	Commitment and perseverance	1	2	1	0	0	4
	Opportunity recognition	0	0	0	1	0	1
	Industry-specific	0	0	0	0	0	0
	Networking	0	0	0	0	0	0
	Σ	14	12	11	7	2	46

[a]Sums are based on relations between competencies and environments. Therefore they differ from sums of learned competencies presented in Chapters 6.1 and 6.2.